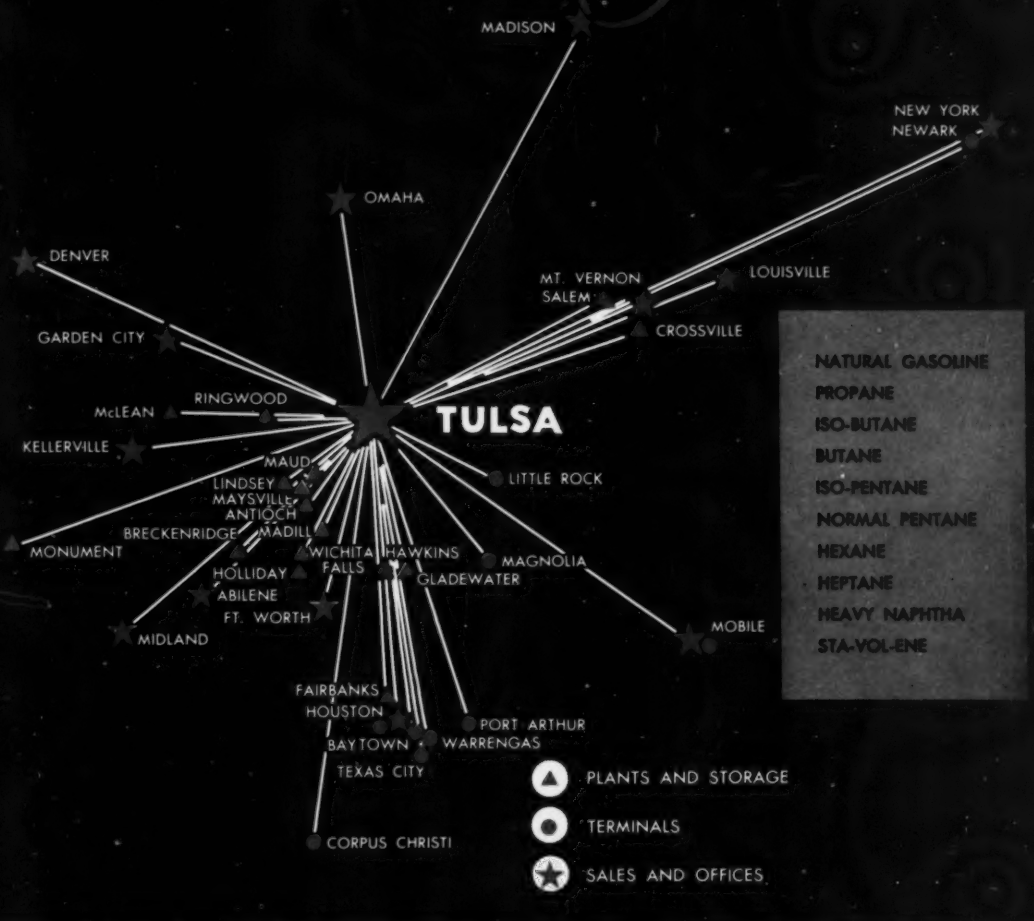
World Petroleum

ONE DOLLAR PER COPY

22ND ANNUAL REFINERY ISSUE

Service Centers



NATURAL GASOLINE
PROPANE
ISO-BUTANE
BUTANE
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NORMAL PENTANE
HEXANE
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HEAVY NAPHTHA
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WARREN

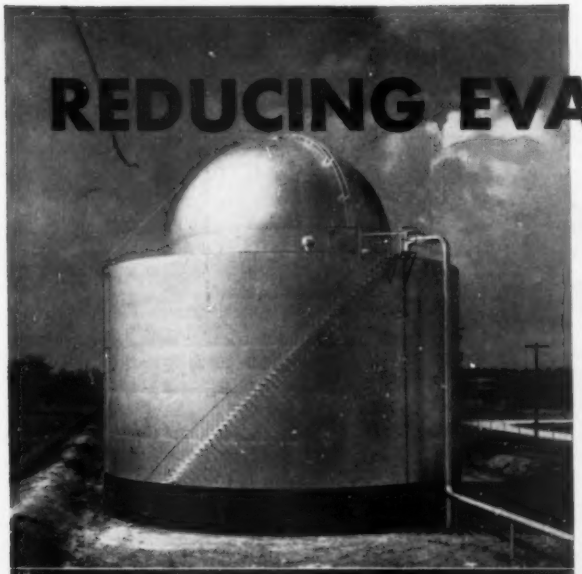
PETROLEUM CORPORATION

TULSA, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN, TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS

REDUCING EVAPORATION LOSSES

in Refineries all over the world



Modern refineries throughout the world choose Horton tanks to help them reduce evaporation losses in the handling and storage of petroleum products. Excessive evaporation can be costly . . . here are three methods of preventing it.

HORTONDOME ROOF **. . . provides facilities for temporary storage of excess vapor caused by breathing or filling. A flexible hemispherical membrane is attached by its outer edge to the equator of the Hortondome. As evaporation takes place or filling occurs the membrane rises to make room for the increased vapor volume or vapor displaced by liquid.**

HORTONSPHEROID **. . . a pressure container for the storage of volatile liquids. Distinctive of shape, the Hortonspheroid reduces evaporation loss by withstanding pressure changes that take place within the tank.**

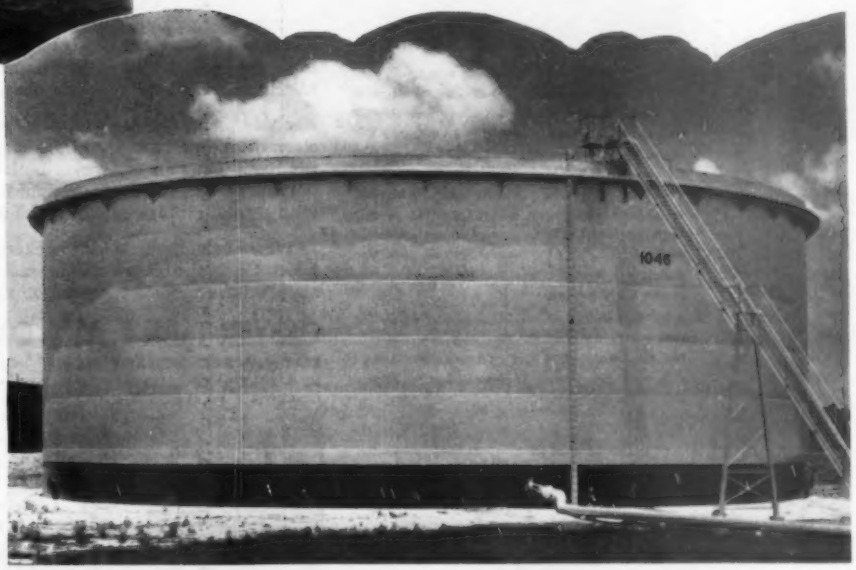
HORTON FLOATING ROOF **. . . eliminates the vapor space in a flat-bottom storage tank by floating directly on the liquid. There is no space under the roof for an air-vapor mixture to form. Horton Floating Roofs are available in three types . . . Double-Deck, Pontoon, and Pan.**

Complete information about the above Horton structures, or any others, may be had by writing our nearest office.

Top: A 60-ft. diam. by 40-ft. storage tank with a 38-ft. diam. Hortondome Roof. It is interconnected with other fixed roof tanks to store their displaced vapor also. All are used to store gasoline.

Center: A 12,000-bbl. Hortonspheroid for storing volatile petroleum products under high pressure. Hortonspheroids are available in standard capacities from 2,000 bbls. to 120,000 bbls.

Bottom: 120,000 bbl. Horton Floating Roof tank built by Chicago Bridge & Iron Company at a Petroleum Refinery in Louisiana.



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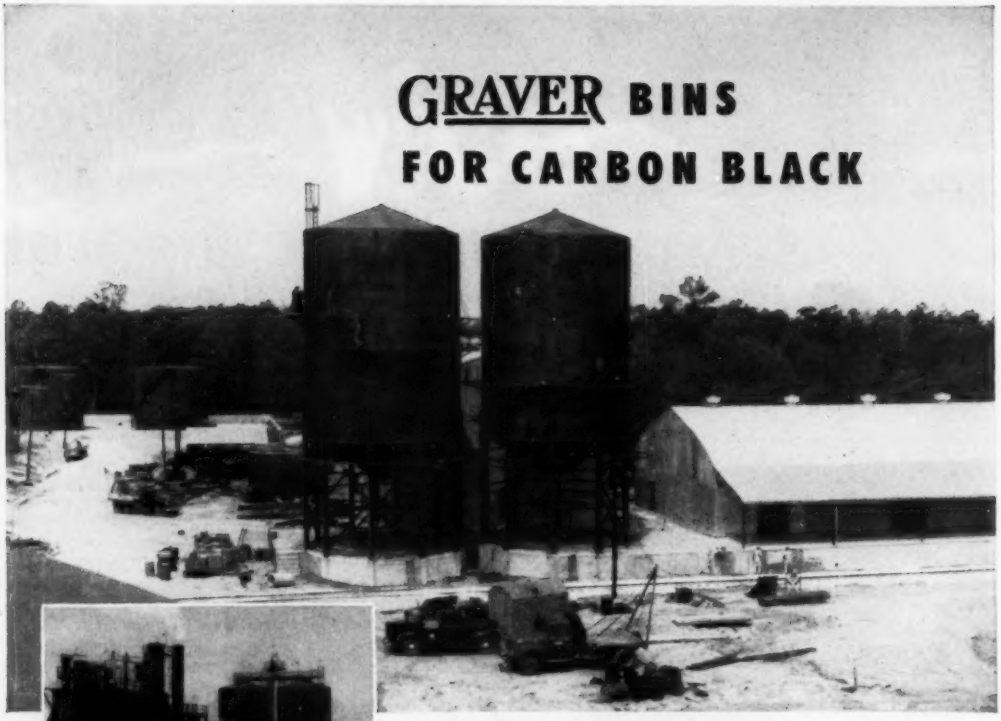
GRAVER BINS FOR CARBON BLACK



Equipped with the most modern processing machinery and centralized controls, this great plant of the Continental Oil Black Co. requires only 29 employees to produce annually 25,000,000 lbs. of high abrasion furnace black, which is marketed by the Witco Chemical Company to the rubber and paint industries. Utilizing gas, oil, process water and emergency steam from the nearby Continental Oil Refinery, the plant represents industrial planning of a high order and operating excellences of such a level that the highest quality products are produced.

A joint operation of the Continental Carbon Co. and the Continental Oil Co., this new plant of the Continental Oil Black Co. was engineered and built by United Engineers & Constructors Inc of Philadelphia.

AT WITCO - CONTINENTAL'S NEWEST OIL BLACK PLANT IN WESTLAKE, LOUISIANA

Now producing high abrasion furnace black at the rate of 25,000,000 lbs. a year, this plant — the most modern in the industry — is the latest addition to the great petroleum and chemical installations in the Lake Charles area.

For this plant, Graver supplied the tankage for the oil feed stocks to be processed and the bins to receive the finished product. The pair of Graver-built bins, of cone roof and cone bottom design, each measure 30′ in diameter by 38′ 4″ high with a total storage capacity of 1,500,000 lbs. of oil black.

In view of the high standards exercised by the Continental Oil Black Co. in the choice of equipment, Graver is pleased to have supplied the process tankage for this notable installation.

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

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CINCINNATI • CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

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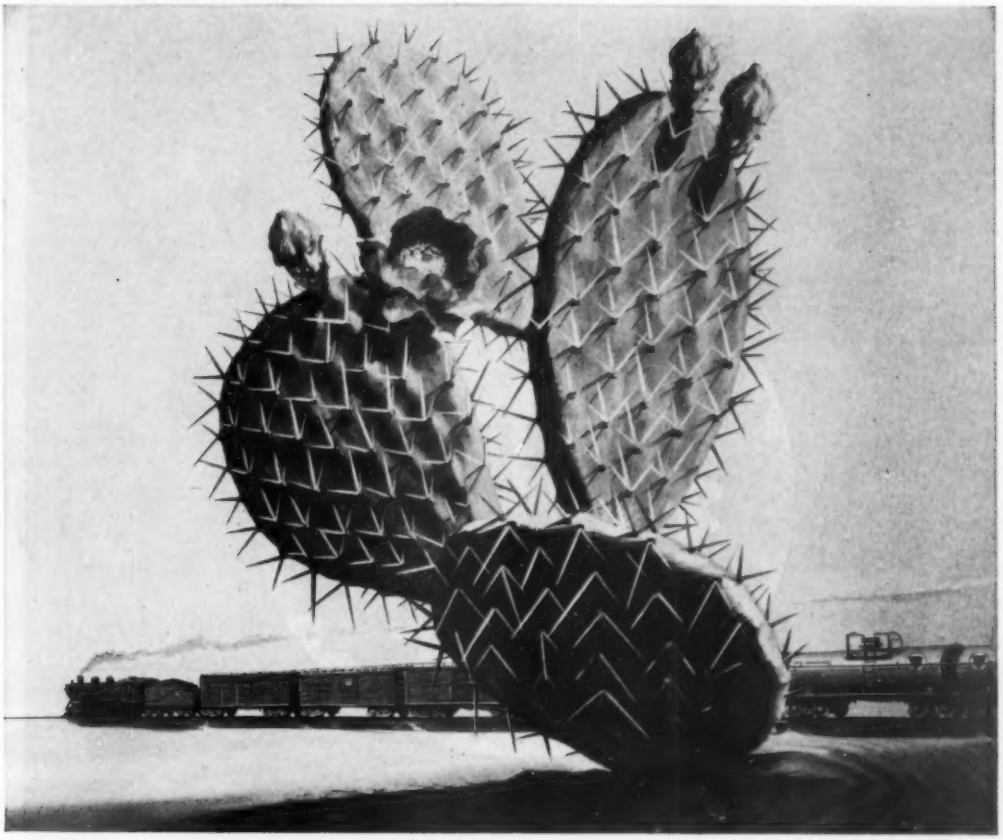


We're shipping from Texas now!

Cars of "Ethyl" antiknock compound are now starting to roll out of our new Texas plant.

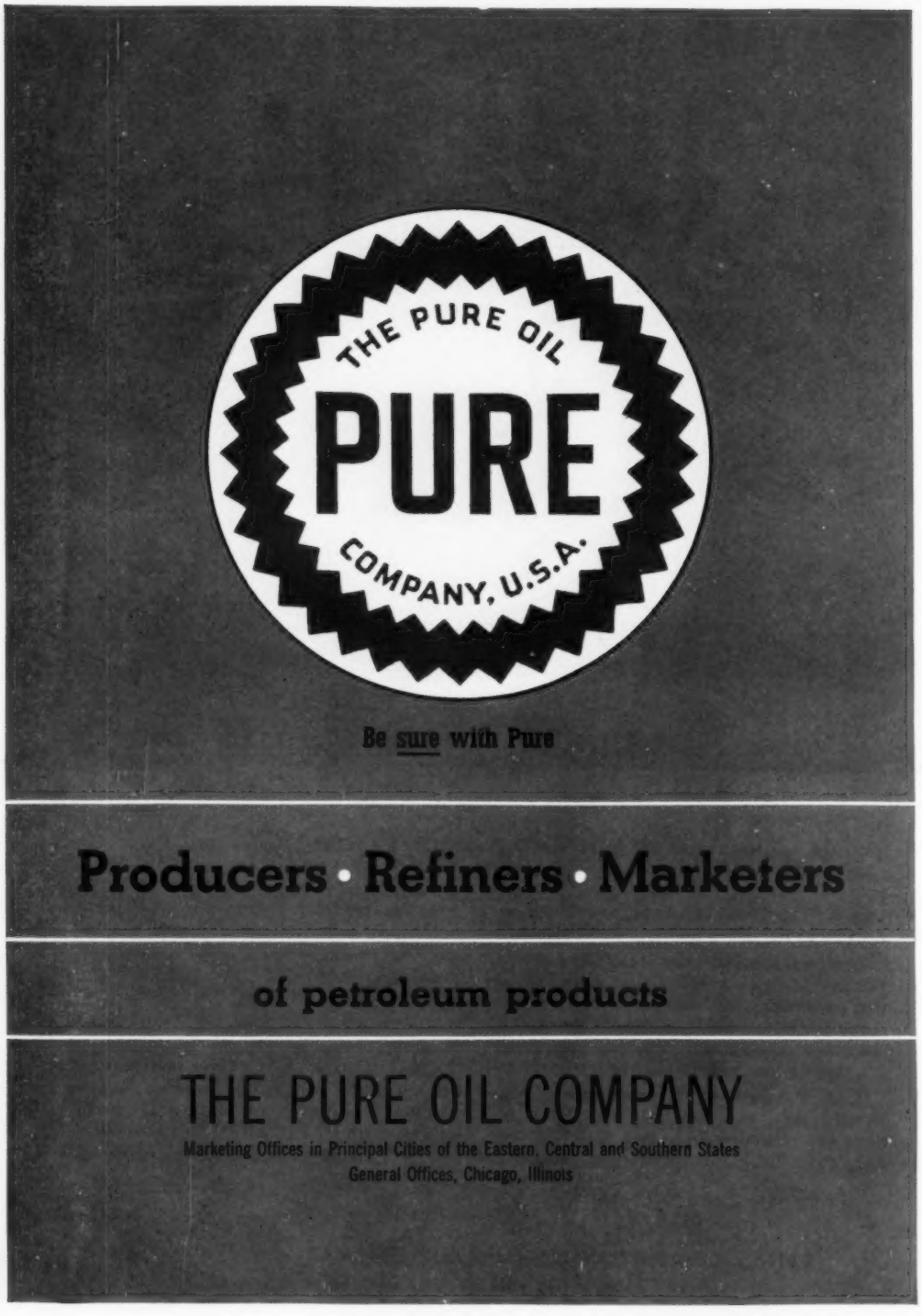
In case you haven't heard the full story of this new plant . . . we have just completed a new antiknock compound manufacturing center on the Houston ship channel in Texas. It's the most modern plant of its kind in the world . . . the only one west of the Mississippi.

This new plant greatly increases Ethyl's manufacturing capacity, and our ability to serve the nation's petroleum industry. It's a completely "integrated" plant. All the complex chemicals needed to produce tetraethyllead are made here from raw materials such as salt, pig lead, petroleum gases and electricity. The location of the new plant was picked to be near these basic raw materials.

Today, we can dispatch Ethyl fluid to you from any one of *four* shipping points: Baton Rouge, Louisiana; Houston, Texas; Edge Moor, Delaware; and Wilmington, California. Refiners are now, more than ever before, assured of a dependable supply of "Ethyl" antiknock compound delivered where and when they want it.

ETHYL CORPORATION, New York 17, N.Y.

Ethyl Antiknock Ltd., in Canada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"I wonder what happened to me !", said Alice

ALICE in Wonderland ate the magic cake and grew until she was more than nine feet tall. Our National bureaucracy also seems to have partaken of the magic cake of power. Bureaus in our government have grown in number and scope until their activities now control, to a great extent, the lives of all individual Americans. Department after department adds more and more people -- state, justice, commerce, treasury -- not to mention those sprawling emergency born agencies of price control, N.P.A. and other alphabetical subdivisions.

The number of employees of our federal, state and local governments continues to grow. During many recent months, personnel was added to the federal payroll at the rate of 1,500 daily.

What is the reason for this mushrooming? The Korean War? Threat of war in Europe, Southeast Asia, or the Middle East? Obviously not! A glance at the federal budget gives the answer. The estimated cost of all governmental functions for the fiscal year 1952 is in excess of 70 billions of dollars, an increase of 26 billions, or approximately 60% more than last year.

When will it end? Only you, the individual citizen, who carries the bureaucratic load on his back, can stop it. It will end when enough patriotic men and women demand from congress that the Washington Wonderland start shrinking back to reasonable proportions.

YOUR SCRAP YOUNGSTOWN IS NEEDED

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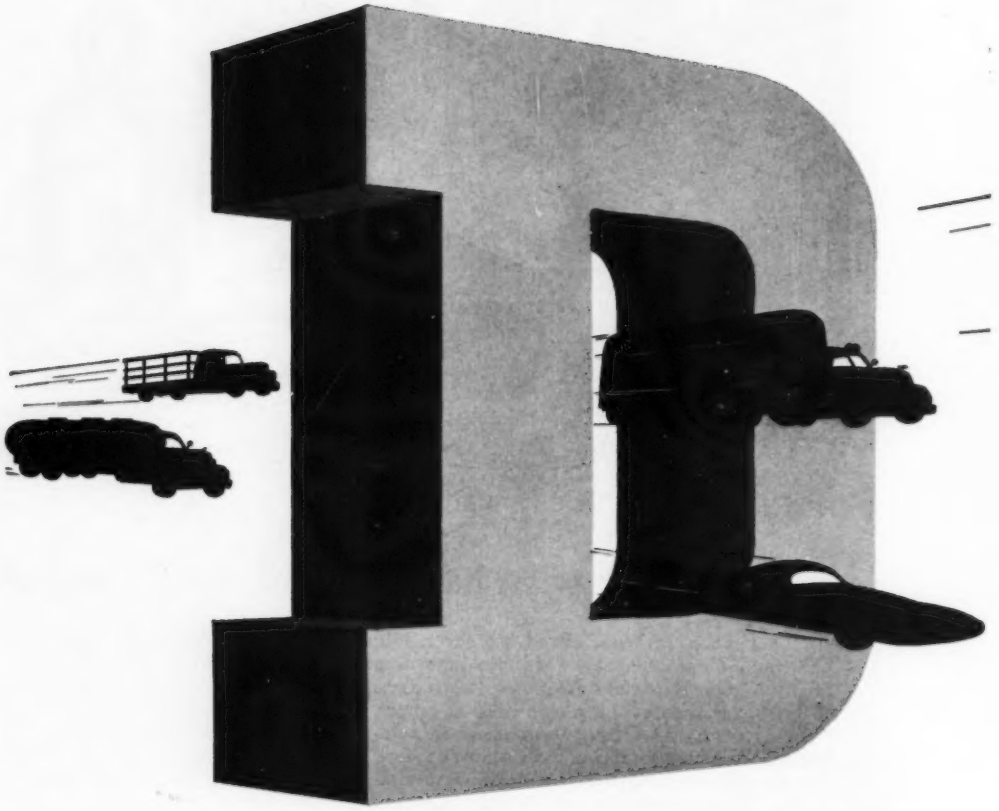
The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment.



DAVISON DEPENDABLE CATALYSTS BUILD BETTER MOTOR FUEL

The operating efficiency of synthetic fluid-type cracking catalysts is important. This operating efficiency can be assured by uniformity of physical characteristics and chemical purity. Davison's production of microspheroidal (M-S*) is tops in uniformity . . . providing all users with a highly efficient synthetic fluid-type cracking catalyst. Your requirements can also be supplied in ground (DA-1*) form. Write for further descriptive information. Experienced Davison Field Service Engineers backed up with complete laboratory testing facilities are part of Davison's service.

*T.M.T.D.C.C.

Progress Through Chemistry

THE DAVISON CHEMICAL CORPORATION

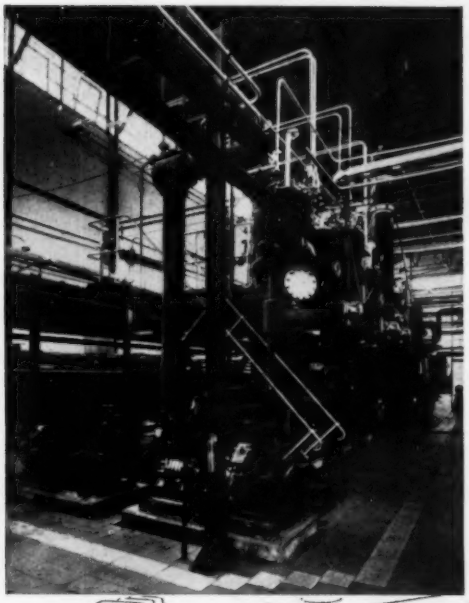
Baltimore 3, Maryland

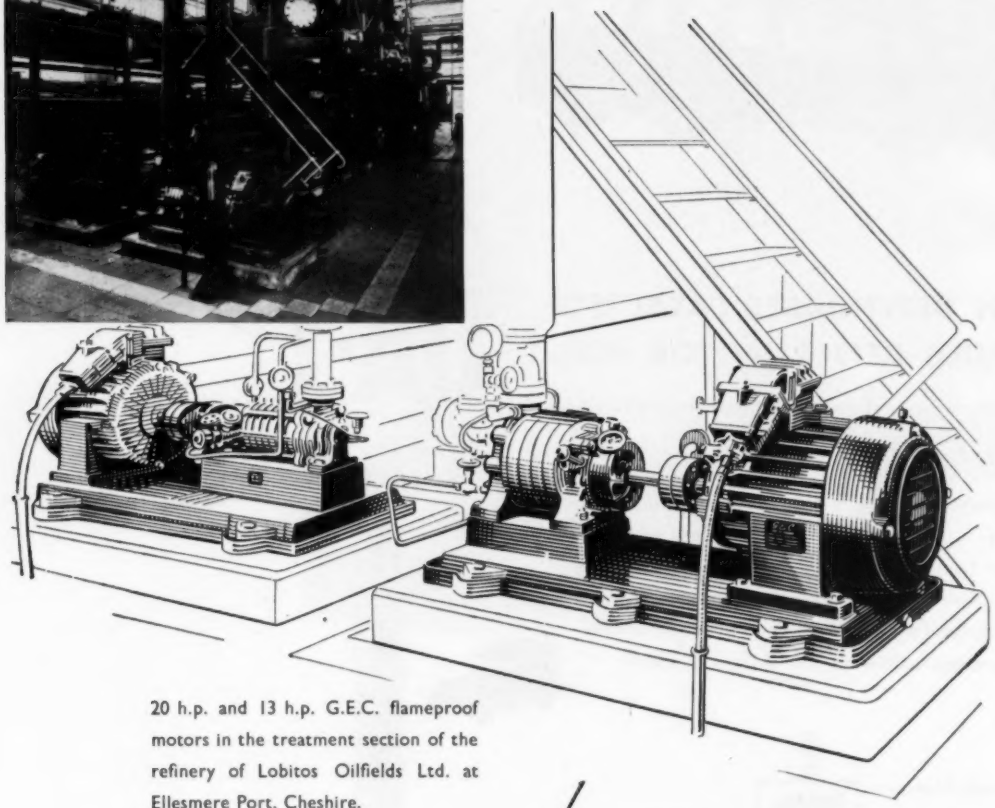
PRODUCERS OF: CATALYSTS, INORGANIC ACIDS, SUPERPHOSPHATES, PHOSPHATE ROCK, SILICA GELS, SILICOFLUORIDES AND FERTILIZERS

ELECTRIC DRIVES

in the

Petroleum Industry





20 h.p. and 13 h.p. G.E.C. flameproof motors in the treatment section of the refinery of Lobitos Oilfields Ltd. at Ellesmere Port, Cheshire.

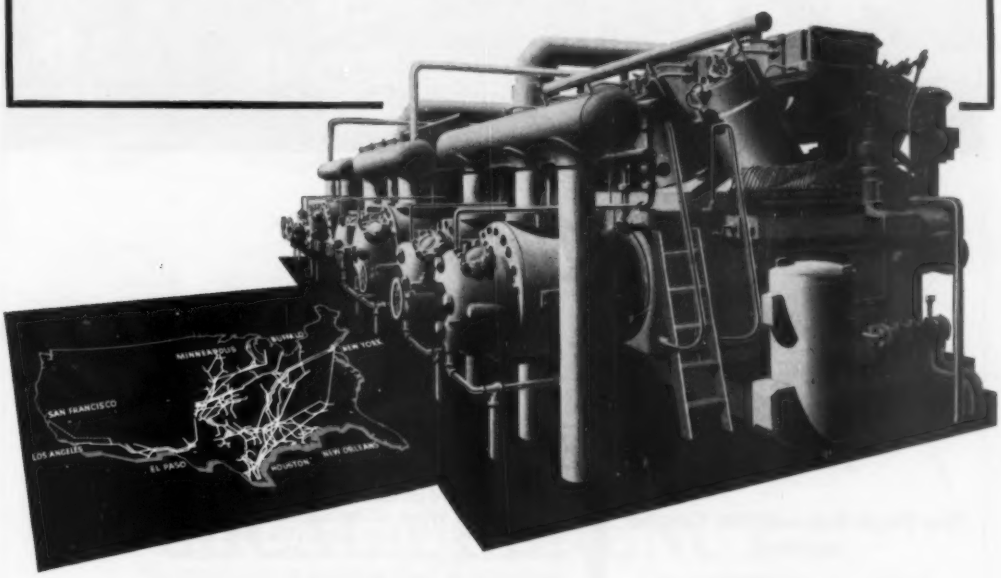
The G.E.C. supplied the whole of the electrical equipment for an important section of this refinery.

by G.E.C.

THE GENERAL ELECTRIC CO., LTD., OF ENGLAND, MAGNET HOUSE, KINGSWAY, LONDON, W.C.2.

GULF SECURITY OIL

provides better lubrication
for pipe line compressor units,
helps prevent operating troubles



Here's the lubricant you can depend on to help keep your pumping stations operating smoothly and continuously—Gulf Security Oil. It provides effective protection for cylinders and bearings in both engines and compressors.

Because of its excellent resistance to oxidation, Gulf Security Oil stands up for many hundreds of hours without any appreciable change in its original properties. After years of operation with this quality lubricant, equipment shows remarkable freedom from cylinder wear and a minimum of carbon deposits on valves and rings. And because oil control rings are kept clean, oil consumption is remarkably low.

Operators of the many units lubricated with Gulf Security Oil report that this quality lubricant helps them get more operating hours between overhauls, and avoid unscheduled shutdowns.

For additional information on Gulf Security Oil and for the services of a Gulf Lubrication Engineer, get in touch with your nearest Gulf office today. Write, wire, or phone.

Gulf Oil Corporation · Gulf Refining Company,
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for Versatility and Accessibility

Our Single Responsibility Contract includes:

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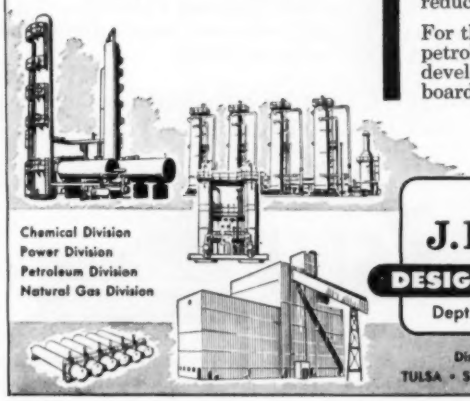
- "Turnkey" Basis

This unit is typical of Pritchard's forward looking ingenuity in Design, Engineering and Construction. Designed to the customer's requirements for replacement of an existing crude unit and for processing six different types of crude oil at a nominal capacity of 22,500 bbls. day, this unit simultaneously produces eight different distillate fractions ranging from light gasoline to cylinder stock!

At the same time particular care was taken to design the unit for maximum accessibility to the heat exchanger equipment, thus facilitating handling and reducing "shut down" time and maintenance costs.

For the most modern advancements in petroleum processing, let Pritchard engineers develop your next project from drawing board to "on stream."



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Power Division
Petroleum Division
Natural Gas Division

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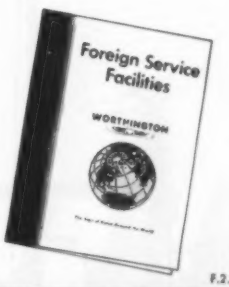
in the CORRESPONDING LOCAL CURRENCY

Many of the hundreds of Worthington products are manufactured in the countries listed above. This means that you can buy equipment that is *engineered and built to Worthington high-quality standards* in the local currency of any of these countries. For complete facts on Worthington facilities around the world, write for Bulletin WP-1099-B54 to Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Export Dept., Harrison, N. J., U. S. A.



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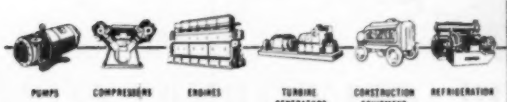
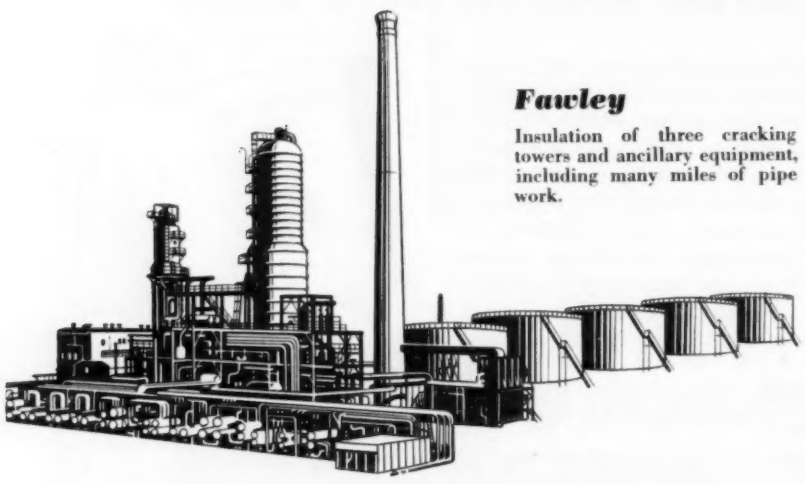


WORTHINGTON

The Sign of Value Around the World

Britain's newest Refinery plants are insulated with

DARLINGTON
85% MAGNESIA
Insulation



Fawley

Insulation of three cracking towers and ancillary equipment, including many miles of pipe work.

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Insulation of three 150 ft. high steel chimneys, boilers and other steam plant.

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Insulation of pipe work and fractionating towers. Cork also fitted on low temperature equipment.

Contractors:
THE DARLINGTON INSULATION CO. LTD.
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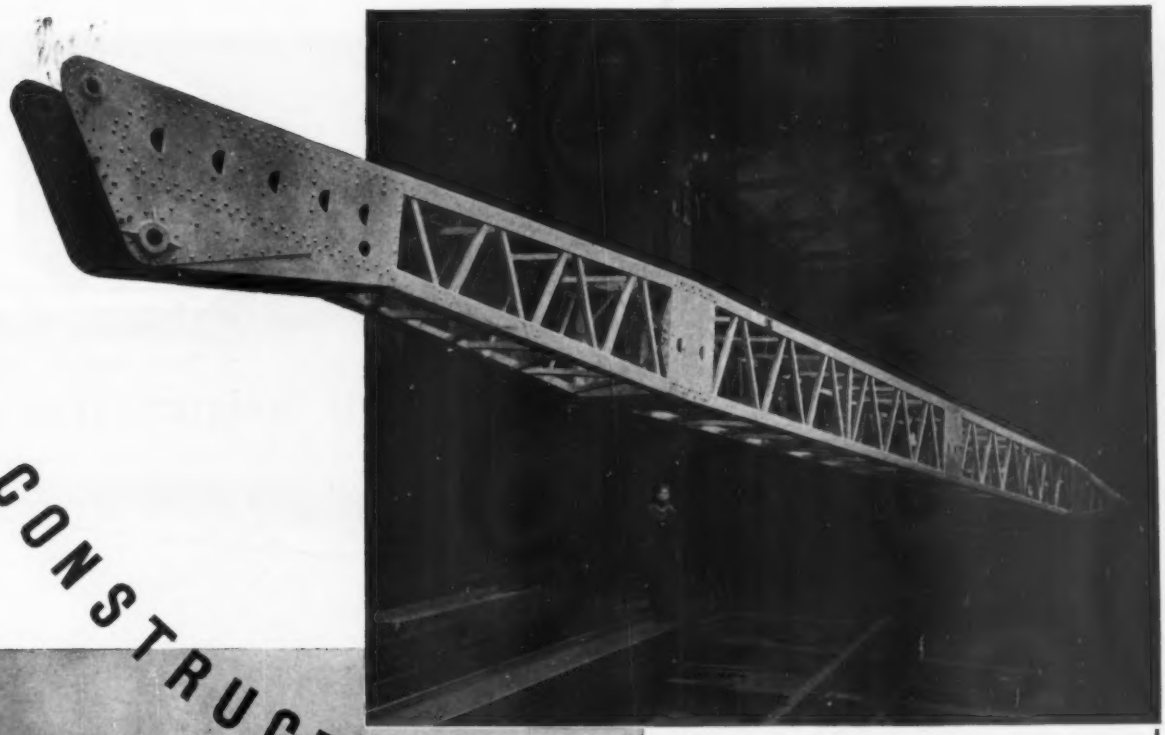

150ft. Mild Steel Riveted Derrick Mast photographed in the Butterley Constructional Department.

CONSTRUCTIONAL STEELWORK by

A view taken in the open before despatch.

BUTTERLEY

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Royal Sulphuric Acid Works

Ketjen Founded 1835

Amsterdam – The Netherlands

are now building on their sites in Amsterdam,
a plant for the production of

M.S. fluid cracking catalyst

according to the processes of
AMERICAN CYANAMID COMPANY
New York.

THIS PLANT WILL START PRODUCTION IN 1953

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OPEN STEEL
FLOORING

REGISTERED TRADE MARK

OIL REFINERIES

WE ARE SUPPLYING COMPLETE ACCESS MATERIALS FOR MANY OF THE MAJOR INSTALLATIONS IN CONNECTION WITH THE U.K. OIL REFINERY EXPANSION PROGRAMME COMPRISING:- LIONWELD OPEN STEEL FLOORING "SUREFOOT" STAIRTREADS AND HANDRAILING.
OUR PRODUCTS ARE EXPORTED ALL OVER THE WORLD.

May we send you full details?

LIONWELD, LIMITED.

PATENTEES & SOLE MANUFACTURERS,
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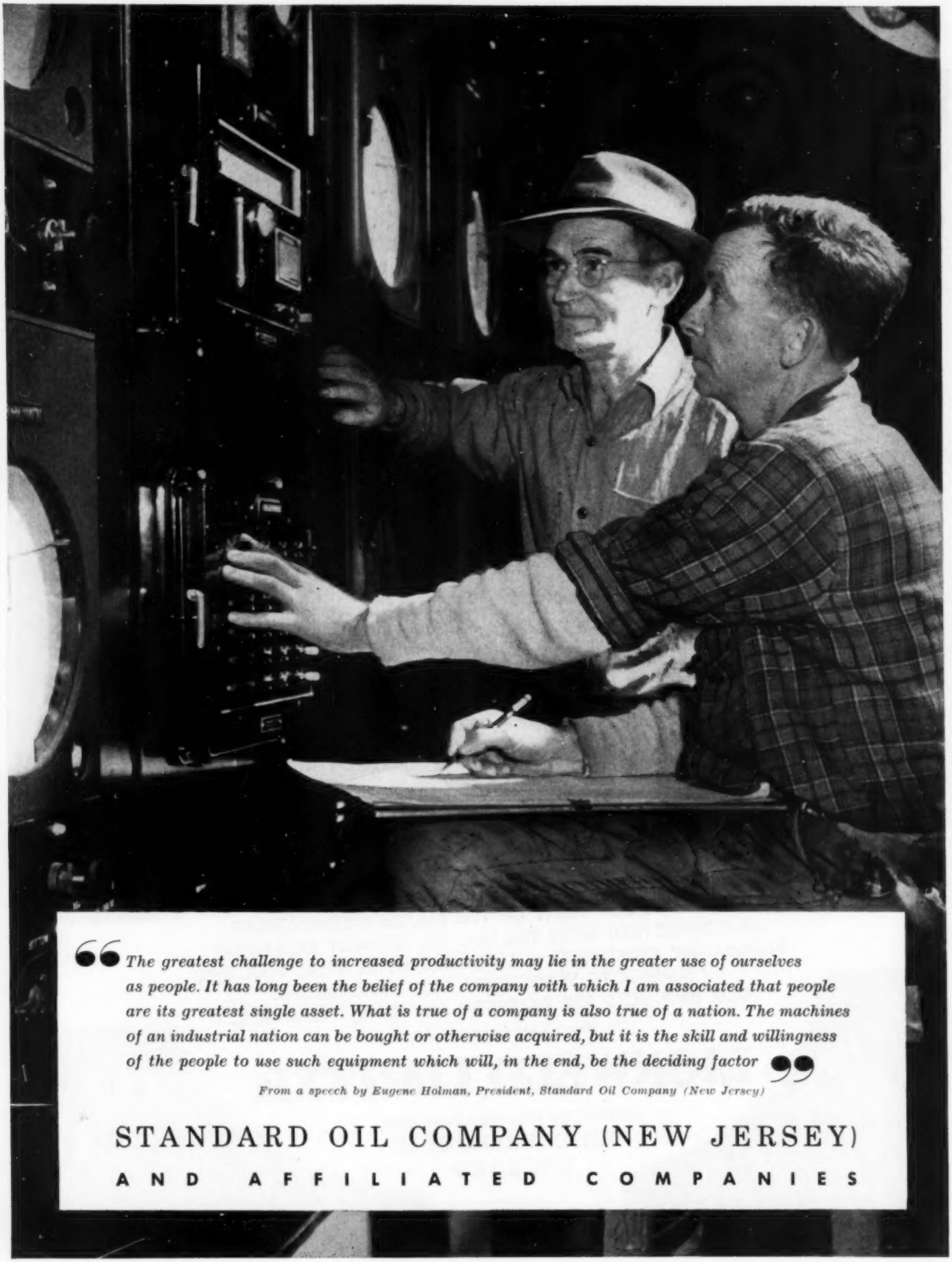

"The greatest challenge to increased productivity may lie in the greater use of ourselves as people. It has long been the belief of the company with which I am associated that people are its greatest single asset. What is true of a company is also true of a nation. The machines of an industrial nation can be bought or otherwise acquired, but it is the skill and willingness of the people to use such equipment which will, in the end, be the deciding factor"

From a speech by Eugene Holman, President, Standard Oil Company (New Jersey)

STANDARD OIL COMPANY (NEW JERSEY)

AND AFFILIATED COMPANIES

PETROLEUM CHEMICALS DIVISION
NEWS

July ★ One of a Series of Interest to the Petroleum Industry ★ 1952

Du Pont Celebrates 150th Anniversary

Six thousand Du Pont employees with 10 years of service or more will attend the company's 150th Anniversary ceremonies on July 18th at the site of the original powder mills along the historic Brandywine at Wilmington, Delaware.

Dramatic episodes in the company's history will be enacted on this occasion, augmented by the Du Pont chorus. Speakers will point out the broad philosophy of the company and the effect this philosophy had on its growth. Mr. Crawford Greenewalt, President, will speak on the future of the Du Pont Company, not in a material way, but rather in consideration of the problems of a large corporation in the coming years.

Wide Range of Movies Available to Oil Companies Through Du Pont Film Library

To help you relate your sales promotion activities as closely as possible to the individual interests of your various customer groups, Du Pont makes available to the oil companies a comprehensive assortment of films.

They cover a wide variety of subjects . . . gasoline quality, safety, automotive maintenance, farming and lubrication. There are many general interest films, too . . . on oil industry operations and economics, on research, on the free enterprise system, and even one on how color conditioning can improve working conditions and employee relations in offices and plants.

Not all of the films were produced by the Du Pont Company. Many of them were originally made by the U. S. Bureau of Mines, by oil companies and by automotive parts makers. But for your convenience, they are available through the Du Pont Film Library.

MANY USES

Several of the films are suitable for dealer training and employee education, as well as for sales promotion. And the new Du Pont movie, "Pipeline on Wheels," is specially tailored to the oil industry's public relations needs.

How can you obtain the films? Just write the nearest Du Pont Petroleum Chemicals Division district office for a brochure describing the films in detail and giving complete instructions on how to request the films you want.

"PIPELINE ON WHEELS" Movie Wins A Top Safety Award

Oil Executives Aided in Production of Film . . . Helped Make it an Outstanding Success

The Petroleum Chemicals Division of the Du Pont Company was recently advised by the National Committee on Films for Safety that it had won one of the committee's annual awards for the motion picture, "Pipeline on Wheels."

BEHIND THE SCENES—"Pipeline on Wheels" was produced on location by professional Hollywood directors, actors, cameramen and sound and light specialists.

What's Your Standing Among Competitive Octane Ratings?

You'll find the answer to this important question in the July issue of Du Pont's Quarterly Motor Gasoline Survey.

The results of this survey are scheduled to roll off the presses in the middle of July so that copies will be in refiners' hands during the week of July 21st.

This edition should be of particular interest to refiners and marketers – especially since the TEL shortage has been alleviated and government restrictions lifted.

The film was selected as a co-winner of top honors in the non-theatrical general classification for movies produced during 1951. It was chosen on the basis of its contribution to safety as well as for technical excellence.

OIL MEN CONTRIBUTE

Although "Pipeline on Wheels" was produced by Du Pont for the oil industry, many oil men contributed to its success. In preparing the script, Du Pont consulted over a hundred representatives of the API and NPA, executives of individual oil companies, automotive engineers and safety officials. Their enthusiastic cooperation brought forth many suggestions and ideas which were incorporated in the film. As a result, the film is accurate and authoritative.

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED *Movie Award*

PUBLIC RELATIONS VALUE

The main objective of this full-color sound movie is to help oil companies overcome some of the prejudice against operating tank trucks on public highways. Produced in Hollywood, the film is specially designed to show the public how tank trucks are built to incorporate every possible safety feature . . . and how the oil companies train their drivers for safe highway operation. It also emphasizes the fact that gasoline tank trucks are vitally important to our modern motorized civilization.

By presenting a case for the tank truck, it is a valuable public relations tool for the oil industry. As such, it is suitable for oil company showings to municipal authorities, safety groups, civic organizations, state highway officials and legislative groups.

All demonstrations shown in the picture are authentic and filmed under the actual conditions described in the script. One of the dramatic highlights of the movie, for example, occurs when an ultra-hot gas-jet fire is built under a tank truck trailer loaded with gasoline. This demonstration provides *convincing proof* that the modern tank truck can be subjected to a severe fire without exploding.

The film delivers its message in the form of an entertaining human interest story. And besides filling a definite need in public education, the film is an ideal aid for training tank truck drivers and maintenance crews.

AN OIL INDUSTRY EXCLUSIVE

Shortly after "Pipeline on Wheels" was released for showings, the demand for its use exceeded all expectations. Originally, since the movie was produced for the exclusive use of the oil industry, 50 prints were made up. But, as requests for the film came into the Du Pont district offices, it soon became apparent that this quantity was not enough. Today, there are 175 prints in circulation among oil companies throughout the country.

What's more, requests for prints poured in from insurance companies, fire departments, trucking firms and many other interested groups. But, because of Du Pont's policy to distribute the film exclusively through oil companies, all of these requests from non-oil organizations were channeled to the oil companies—to enable them to take full advantage of the public relations value of the film.

NEW HEAD OF EXPORT SECTION

WALTER MEES

Holland-born Walter Mees heads up the petroleum chemicals sales section of Du Pont's Organic Chemicals Department. Mr. Mees' appointment to this position some months ago was part of a substantial expansion of the Company's export organization handling such petroleum chemicals as tetraethyl lead, gasoline dyes and antioxidants, Metal Deactivator, grease stabilizers, lube oil additives and cetane.

After graduating from a commercial and technical college in Holland, Mr. Mees entered business in Canada and abroad. In 1929 he joined the Royal Dutch Shell Group and passed through all phases of the oil industry from drilling to marketing.

In 1935 he entered another field, but returned to Shell in 1945 and until 1949 served as General Management Assistant with the Shell Caribbean Petroleum Company in Venezuela. Mr. Mees joined Du Pont in May 1950 and since that time has worked exclusively with petroleum chemicals products.

New Du Pont TEL Storage and Tank Truck Terminal Being Completed on Pacific Coast

Within a few months, Du Pont's new tetraethyl lead storage terminal at El Monte, California will be functioning full blast on behalf of the oil industry in Southern California.

The terminal, complete with railroad sidings for receipt of tank car shipments; and with weigh tank and storage facilities, will make all deliveries via Du Pont-owned tank trucks.

One purpose of this is to make TEL more conveniently available to those refiners who previously had to receive "lead" in drums due to lack of railroad sidings.

The terminal will also help insure an immediate emergency supply of tetraethyl lead to refiners whose regular shipments may have been held up by local floods, or other delays *en route*. And large refiners who for any reason whatsoever may be in need of rush shipments smaller than in R. R. tank car lots can also benefit by the new tank truck delivery system.

Further, to expedite the handling and delivery of TEL, Du Pont-designed Metal-Flex hose installations are used in both the loading and unloading operations at the terminal.

LITERATURE AVAILABLE

Here is a partial listing of the bulletins, reports, booklets and aids available to you through your Du Pont Petroleum Chemicals Division district office:

Safety for the Small Refinery – A 42-page book on how to set up an effective small refinery safety program . . . . . Serial A-2848

Tank Talk – A 52-page, easy-to-understand safety booklet for tank-cleaning crews . . . . . Serial A-1134

Stability of Present-Day Gasolines – A 12-page paper on the value of storage tests—as compared with induction period—for determining stability of modern gasolines . . Serial A-3199

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ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

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for fifty one years an integral part of refining progress!

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Unique

"Newallastic" bolts and studs have qualities which are absolutely unique. They have been tested by every known device, and have been proved to be stronger and more resistant to fatigue than bolts or studs made by the usual method.

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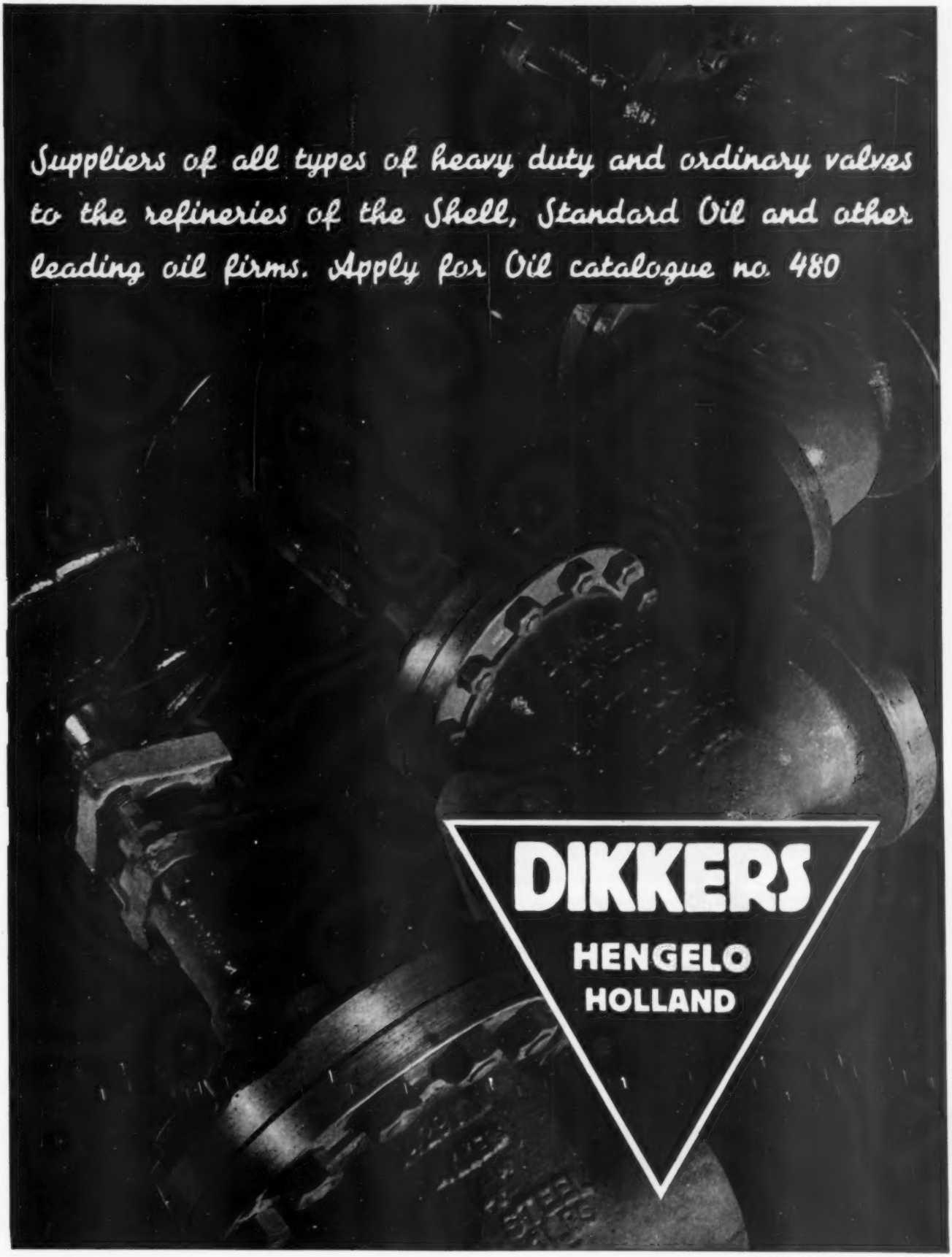
POSSILPARK GLASGOW · N


Suppliers of all types of heavy duty and ordinary valves to the refineries of the Shell, Standard Oil and other leading oil firms. Apply for Oil catalogue no. 480
DIKKERS
HENGELO
HOLLAND

It took two railroad cars to provide "passenger accommodations" for this depropanizer tower—as Sun Ship workers readied it for shipment.

tough bronco—
PETROLEUM!

Ever see a bronco at the first touch of the saddle? Ever see a gusher well come in? The resemblance doesn't end with the furious first burst of action, even though the saddled pony stands quiet . . . and the stream of black gold pours placidly into the refinery—until man renews his taming process.

Breaking a fractious horse . . . cracking petroleum . . . makes them both useful. And both tasks throw the full test of pressure on the men who tackle the job . . . and on the equipment they use.

Tanks and towers . . . in fact all refinery and chemical equipment built at Sun Ship has been meeting the toughest tests of pressure through years of service. That's to be expected. The men of Sun Ship who build it have shown their ability to meet and master the production pressure of time . . . and the engineering and shipping problems that go with the task of constructing and delivering the gigantic equipment that helps build a greater and stronger America.

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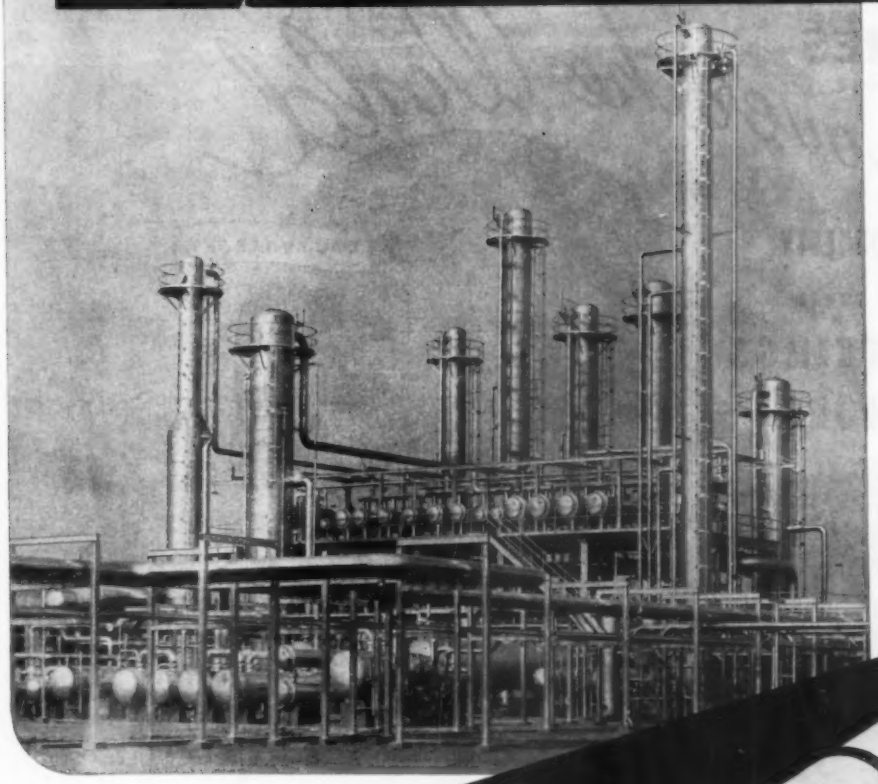
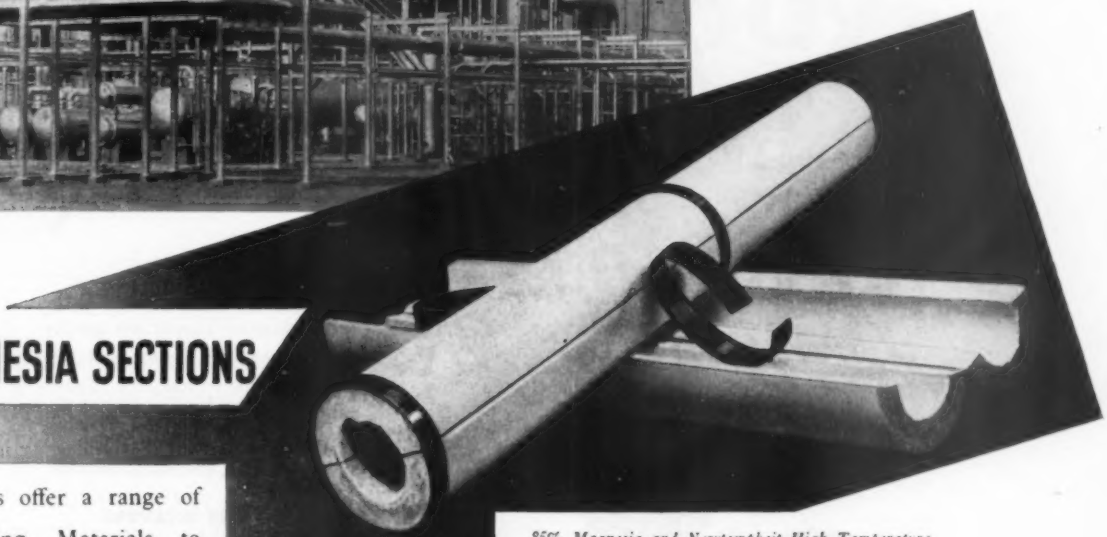
Specializing in Modern Refinery Insulation



Newall's (Regd. Brand) Products have been extensively used on the following Oil Refineries:

Abadan, Antwerp, Aruba, Bahrein, Cardon, Port Jerome (France), Isle of Grain, the new unit at Llandarcy, Shellhaven, etc.

85% MAGNESIA SECTIONS



85% Magnesia and Newtempheit High Temperature Sections available in a wide range of sizes as required.

Newalls offer a range of Insulating Materials to provide efficient and economic insulation for all temperatures from minus 300°F up to 2000°F.

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Newalls' Technical Staff is available for your Insulation problems. Why not consult them ?

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This 24 acre Vogt plant supplies the most comprehensive line of top quality *drop forged* steel piping materials anywhere available to industry. That's why they're the choice of leading refineries, power plants, chemical plants, etc., the world around!

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● Wherever oil is refined—here in America and in the far places of the world—oil men recognize the McKee name as a symbol of engineering integrity.

Refiners know McKee as a source of sound, practical engineering that comes only from long experience and thorough, up-to-date knowledge. They know the conservative business methods which have always characterized this company's activities. They know McKee as an organization with the scope and resources to undertake any refinery project, large or small, and carry it through to completion with efficiency and integrity.

That's why so many refiners use McKee design, engineering and construction services again and again.

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Headquarters: McKee Building, 2300 Chester Avenue, Cleveland 1, Ohio.
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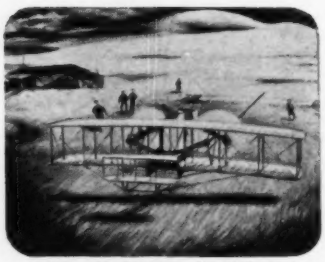
WORLD'S

FIRST, FOREMOST AND LARGEST SELLER

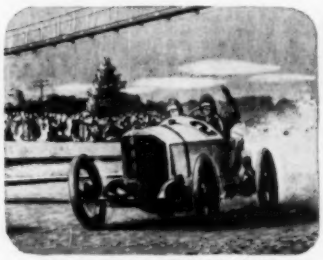
NO OTHER MOTOR OIL CAN MATCH THIS RECORD

Here are just a few Mobiloil "firsts" during last half-century

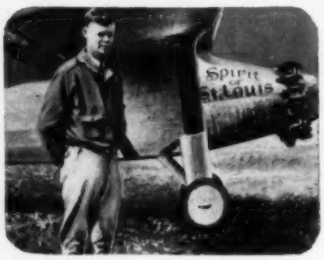


WRIGHT BROTHERS—On their early flights, these pioneers protected their frail engines by using Mobiloil.

BARNEY OLDFIELD—Set many original records, including 131.72 m.p.h. in 1910. Consistently used Mobiloil.

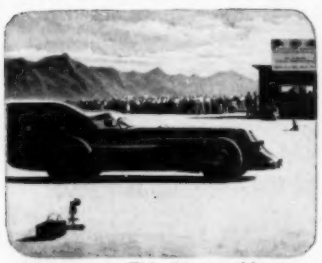


RALPH DE PALMA—This Mobiloil user won 1915 Indianapolis race—also set record for 800-mile run in 120°F heat!



LINDBERGH—Made first non-stop solo flight across Atlantic, New York to Paris, with the help of Mobiloil.

JOHN COBB—Used Mobiloil in his racer when he set the world auto speed mark—394.196 m.p.h.—in 1947.



AB JENKINS—This 69-year-old racer recently set 26 new world and U. S. marks in one day—aided by Mobiloil.

LEE WALLARD—Won 1951 Indianapolis race with record 126.244 m.p.h. average. Used Mobiloil in his engine.

WHY SELL ANYTHING LESS?

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates MAGNOLIA PETROLEUM CO. GENERAL PETROLEUM CORP.

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petroleum
moves
Chas. Martin
inspectors
are on
the job
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Baltimore, Md.
New Orleans, La.
Goodhope, La.
Baton Rouge, La.
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Port Arthur, Texas
Beaumont, Texas
Houston, Texas
Baytown, Texas
Texas City, Texas
Freeport, Texas
Corpus Christi, Texas
Brownsville, Texas
Helena, Ark.
Arkansas City, Ark.
Ras Tanura, Saudi Arabia
Sidon, Lebanon
San Pedro, Calif.
San Luis Obispo, Calif.
San Francisco, Calif.
Seattle, Wash.
Tampico, Mexico
Havana, Cuba
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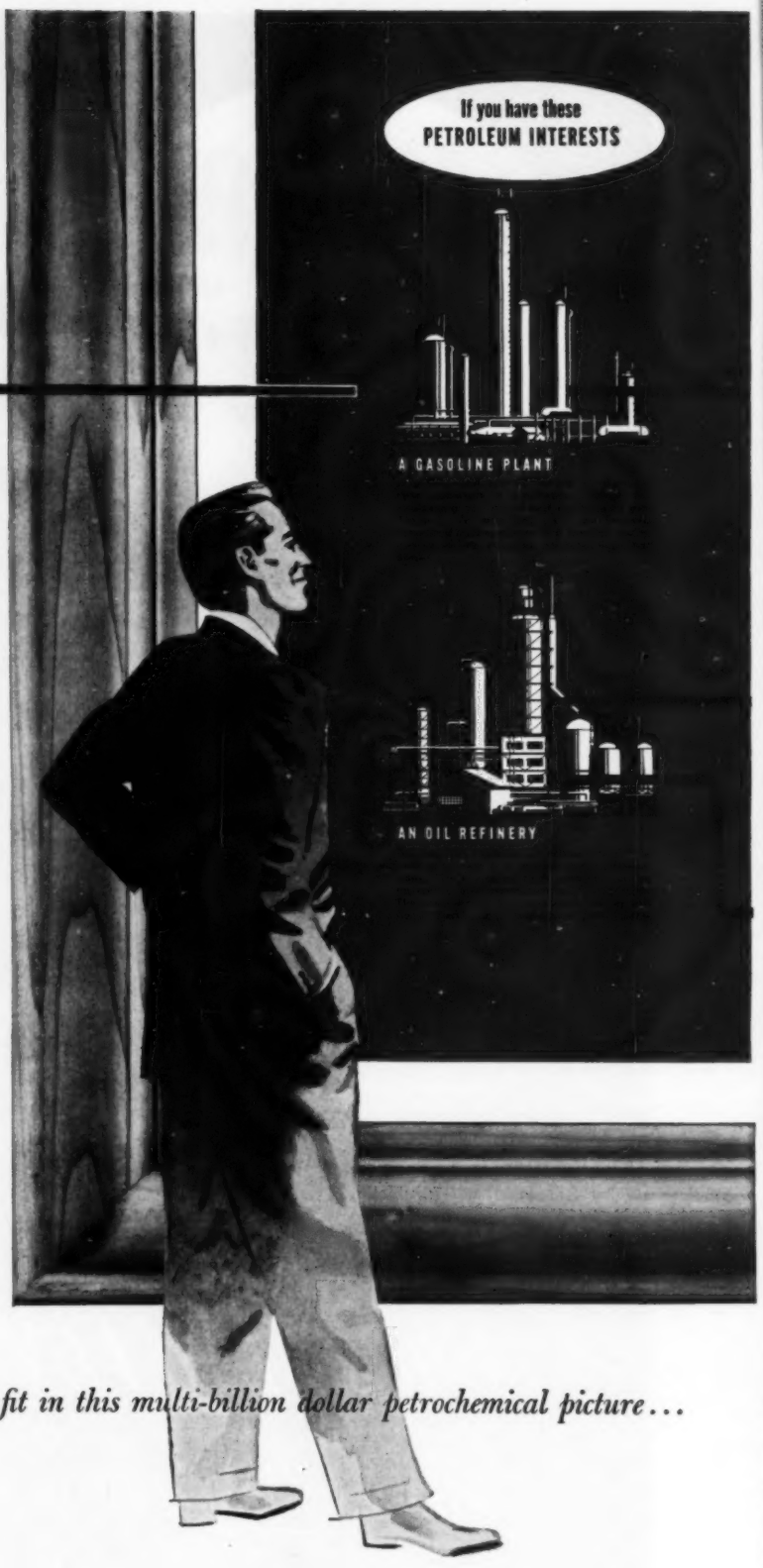
Where do you fit in this multi-billion dollar petrochemical picture?

This important industry is on the boom. Expanding fivefold in 10 years, it promises to double this in the next 10 years.

The young and growing petrochemical industry is the largest new factor in our ever-expanding world of chemicals. The raw materials for this relatively new industry, which accounts for nearly one-quarter of all U.S. chemical production, exist in crude oil, natural gasoline, liquefied petroleum gases, and natural gas. Its growth has been, and continues to be, phenomenal.

Since less than one-half of one percent of all present oil and gas production is being utilized as petrochemical feed stock, the supply of raw materials is virtually unlimited. This offers tremendous potentials to the investor when it is considered that the increase in value of the end petrochemical product can be four or five times greater than that of normal products realized from other hydrocarbon processing operations!

If you own, operate, or have interests in the petroleum industry, you should be aware of *your* potential as a supplier of petrochemical raw materials.



Let Fluor help determine where you fit in this multi-billion dollar petrochemical picture...

Then you have these BASIC RAW MATERIALS

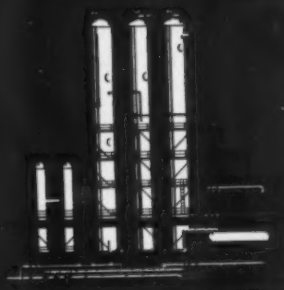
METHANE
ETHANE
PROPANE
BUTANE
ISOBUTANE

METHANE
ETHANE
PROPANE
BUTANE
ISOBUTANE

UNSATURATED HYDROCARBONS

Which can become PETROCHEMICAL FEED STOCKS

ACETYLENE
ETHYLENE
PROPYLENE
BUTYLENE
ISOBUTYLENE



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For the production of these PETROCHEMICAL PRODUCTS

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NEOPRENE
TRICHLOROETHYLENE
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ETHYLENE GLYCOL
ETHYL ALCOHOL
ETHYL CHLORIDE
ETHYLENE DICHLORIDE
ETHYLENE DIBROMIDE
ACRYLONITRILE
POLYETHYLENE
STYRENE
ACETIC ACID
ISOPROPYL ALCOHOL
ACETONE
GLYCERIN
METHYL METHACRYLATE
PROPYLENE GLYCOL
ALLYL ALCOHOL
ALLYL CHLORIDE
BUTYL ALCOHOLS
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SINCE 1909

Let Fluor help you...

The petrochemical industry has opened entirely new potentials for the oil and gas producer and investor. The important question is, "Where do you fit in?"

The proven abilities to design, engineer and construct complete plants and facilities for the petroleum, natural gas and petrochemical industries have established The Fluor Corporation as one of the nation's major engineering and construction organizations. One call to Fluor will place men with broad and diversified experience in petroleum and chemical engineering technology and economy at your disposal. Let Fluor put these talents and facilities to work for you. Find out your potentials in the rapidly expanding petrochemical industry. You will be sure with Fluor!

Matthew Hall & Co., Limited

At the Annual General Meeting of Matthew Hall & Co., Limited, held at 26 Dorset Square, London, on 16th June, 1952, Mr. Bertram Baden, M.C., S.B.St.J., M.I.H.V.E., the Chairman, reported a Group Profit on Trading of £167,659 for the year 1951, before Directors Remuneration, Bank Interest, Depreciation and Taxation, compared with £132,664 for 1950, and that the Directors had placed £10,000 to General Reserve and recommended a dividend of 33 1/3%.

Mr. Baden referred to the proposed bonus issue of one new share for each Ordinary Share held, to be dealt with at the Extra-Ordinary General Meeting to be held after the Annual General Meeting, and went on to say:

AIR CONDITIONING AND HEATING. This side of the business expanded further and covered a very wide field ranging from work at atomic stations to the air conditioning of a chicken brooder house. Some of our other interesting contracts were for vacuum heating and panel heating.

Our Glasgow branch has received what is believed to be the largest heating contract placed in Scotland.

HEAT PUMP. The Royal Festival Hall experimental heat pump which we installed for the Ministry of Fuel and Power was used to provide chilled water to the air conditioning plant during last summer and to provide heat during the winter.

PLUMBING AND GARCHEY SYSTEM. Plumbing in all its aspects forms a large part of our business.

We are installing the Garchey System of Domestic Refuse Disposal for 264 flats in Birmingham.

OIL REFINERIES. Oil refinery contracts included miles of welded pipelines up to 7 ft. 4 in. diameter, the erection of a feed preparation unit and other plant, also electric power and lighting to over 100 buildings on one refinery.

We are supplying oil storage and service tanks and pumps to Trinidad, and have further orders for the Argentine and Singapore.

GENERATING STATIONS. One of our contracts was for the installation of steam turbo-generating plant in Nigeria. It was unfortunate that we had to leave Abadan where we had almost completed the installation of the turbo-generators.

CHEMICAL AND INDUSTRIAL ENGINEERING. We received further contracts for the installation of chemical and industrial plants and process pipework in connection with the manufacture of general chemicals and pharmaceutical products such as anti-biotics, phosphorus and magnesium products, inorganic and fatty acids, solidified carbon dioxide, dyestuffs and rayon.

In Scotland we are erecting plant and pipework for the production of monomeric styrene. The plant includes a number of distillation columns one of which is 132 ft. high and was erected in one piece.

The manufacture and erection of a glass-lined water tunnel for the Admiralty Research Laboratories was successfully completed.

We internally welded a 6 ft. 3 in. diameter experimental water main 100 ft. below ground which necessitated plant to extract the welding fumes from inside the pipe.

One of our interesting contracts in the West Indies is for the mechanical services for a bauxite mine.

We have work on jetties, a 300 ft. conveyor to raise approximately 150 tons per hour to a height of 60 ft., evaporators and dryers, crystallizers, cyclones, reaction vessels, autoclaves and centrifuges, and in connection with the extraction of magnesia from sea water.

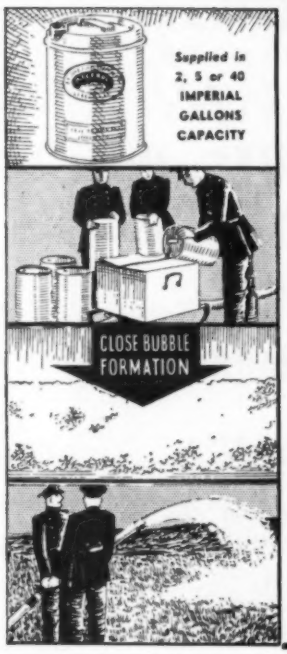
MATTHEW HALL (PTY.) LTD., SOUTH AFRICA. Contracts awarded this company during the year included the erection of chemical and industrial plant and process pipework also air conditioning and dust extraction, heating, electrical, plumbing, lead-burning and automatic sprinkler installations, for diamond, gold and copper mines, offices, factories, flats and departmental stores. The Germiston factory continues in full production; the Welkom, Orange Free State, factory has commenced production, and the new factory at Durban should be in production this year.

We had another good year for export trade on the merchanting side of our business.

In closing this review it is a pleasure to express the Board's appreciation to all employees for their loyal service during the year.

The report and accounts were adopted.

Kills Oil & Petrol Fires with SPEED & CERTAINTY



★ Nicerol is supplied in heavy gauge steel drums designed for quick release and clean pouring.

★ Nicerol can be used in any type of mechanical foam or air foam apparatus. In this case a base injection type in-line inductor is being operated.

★ The secret of Nicerol effectiveness lies in the small bubble formation. It creates a tough, efficient blanket. 3 gallons of Nicerol and 100 gallons of water will produce over 1,100 Imperial gallons of foam.

★ The above gasoline and oil blaze was extinguished in a matter of seconds by a normal mix of Nicerol Foam Compound.

Meet the hazard of fire with Nicerol, the foam compound that kills any oil or gasoline fire quickly and absolutely. Nicerol is a concentrate, producing a heavy type foam of closely-knit small bubbles which form a tough, vapour-tight blanket over the surface of burning oil or gasoline. It is characteristic of Nicerol Foam that it flows with the fire and is highly resistant to flash-back or re-ignition. It can be used successfully in any type of mechanical foam or air-foam apparatus — is equally effective with salt water or fresh and can be stored for years without deterioration.

TRADE ENQUIRIES INVITED

For further particulars, samples, catalogues, etc.:

The Royal Navy and the Royal Air Force use it and so do Oil Companies, Fire Equipment Manufacturers, Civil Air Lines, several Commonwealth and Foreign Government departments, and Fire Brigades throughout the world. What better recommendation?

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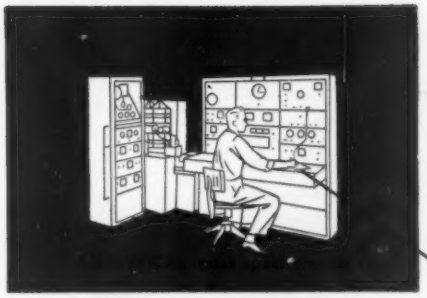
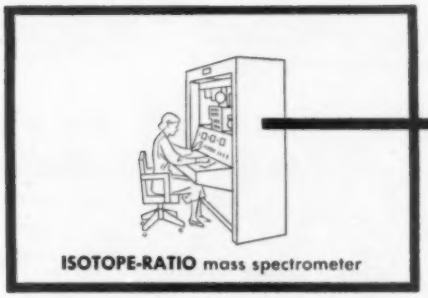
an analytical and isotope-ratio mass spectrometer combined



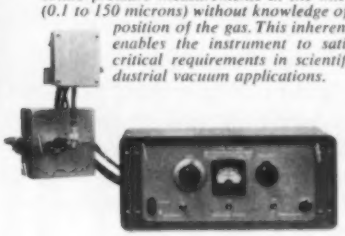


CONSOLIDATED'S new Model 21-401 Mass Spectrometer is a compact, medium-priced instrument, ideal for those laboratories having moderate analytical loads. Highly versatile, it provides not only quantitative analyses of gaseous or light-liquid mixtures as automatically recorded mass spectra, but *also* precise *recorded* ratios of stable gaseous isotopes. Like the widely used Model 21-103, it is exceptionally accurate and incorporates many automatic, time-saving features. For the multitude of industrial and scientific applications not requiring extremes of mass range, sensitivity, and operating speed, the Model 21-401 is of maximum value. Write for Bulletin CEC-1821.

Model 21-401 Mass Spectrometer

Analytical Instruments for Science and Industry

Micromanometer, Model 23-105 *provides precise, absolute pressure measurements in the micron range (0.1 to 150 microns) without knowledge of the composition of the gas. This inherent property enables the instrument to satisfy many critical requirements in scientific and industrial vacuum applications.*



Consolidated Engineering
CORPORATION
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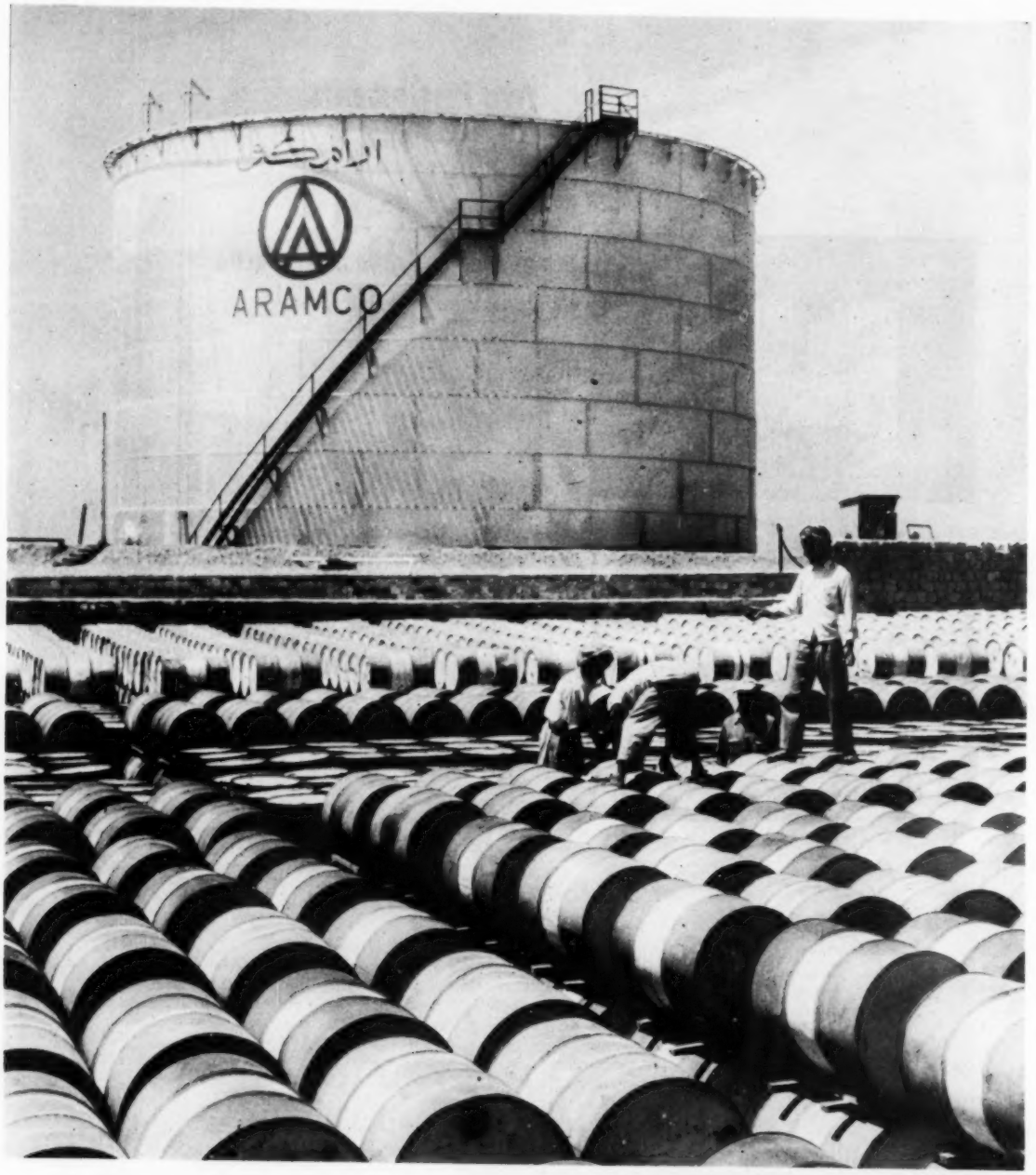
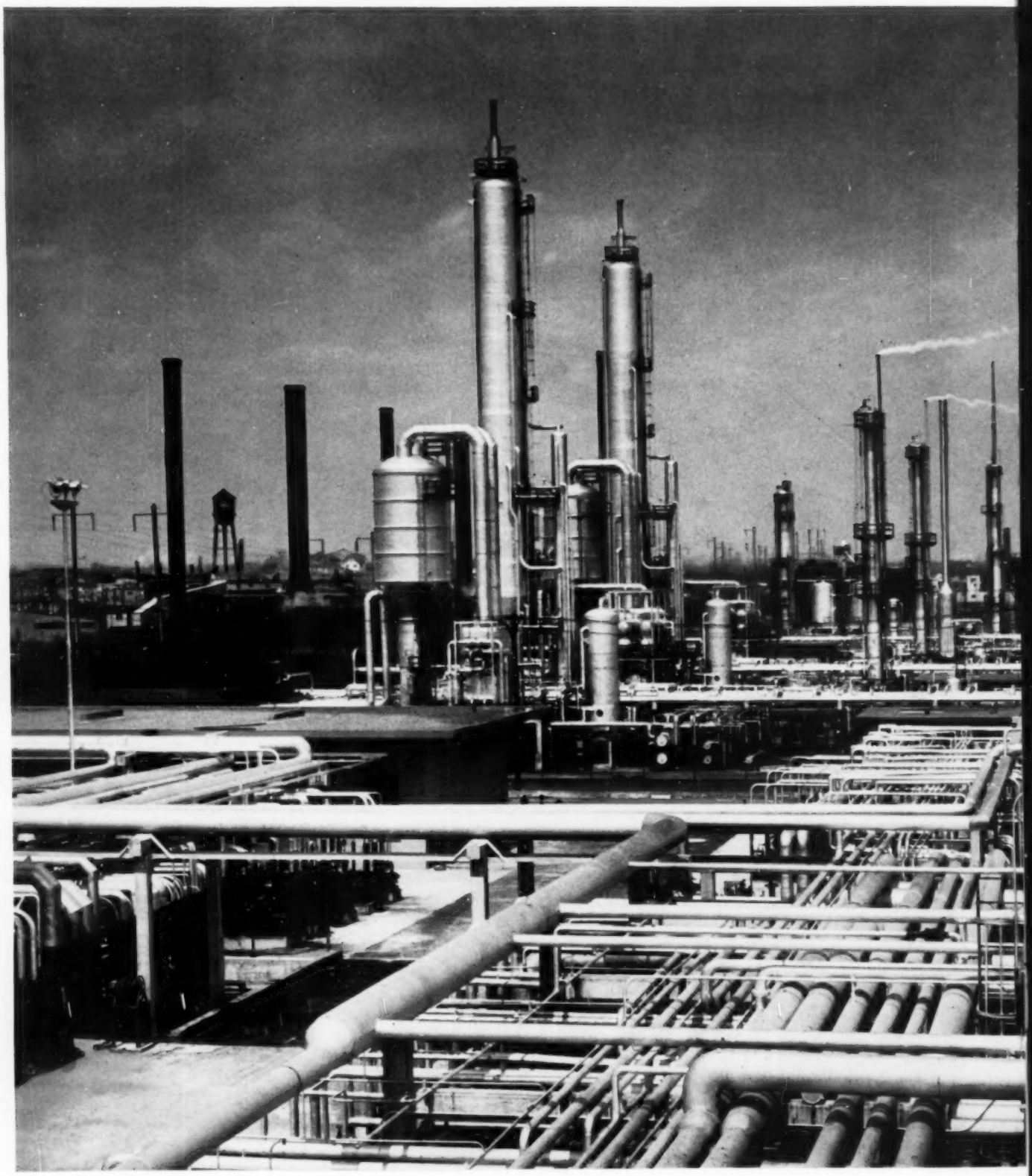


To help supply the rapidly growing petroleum needs of western Saudi Arabia, Aramco has just completed a new bulk plant at Jeddah, on the Red Sea.
The distribution center has a storage capacity of more than 150,000 barrels of motor and aviation fuel, kerosene and diesel oil.

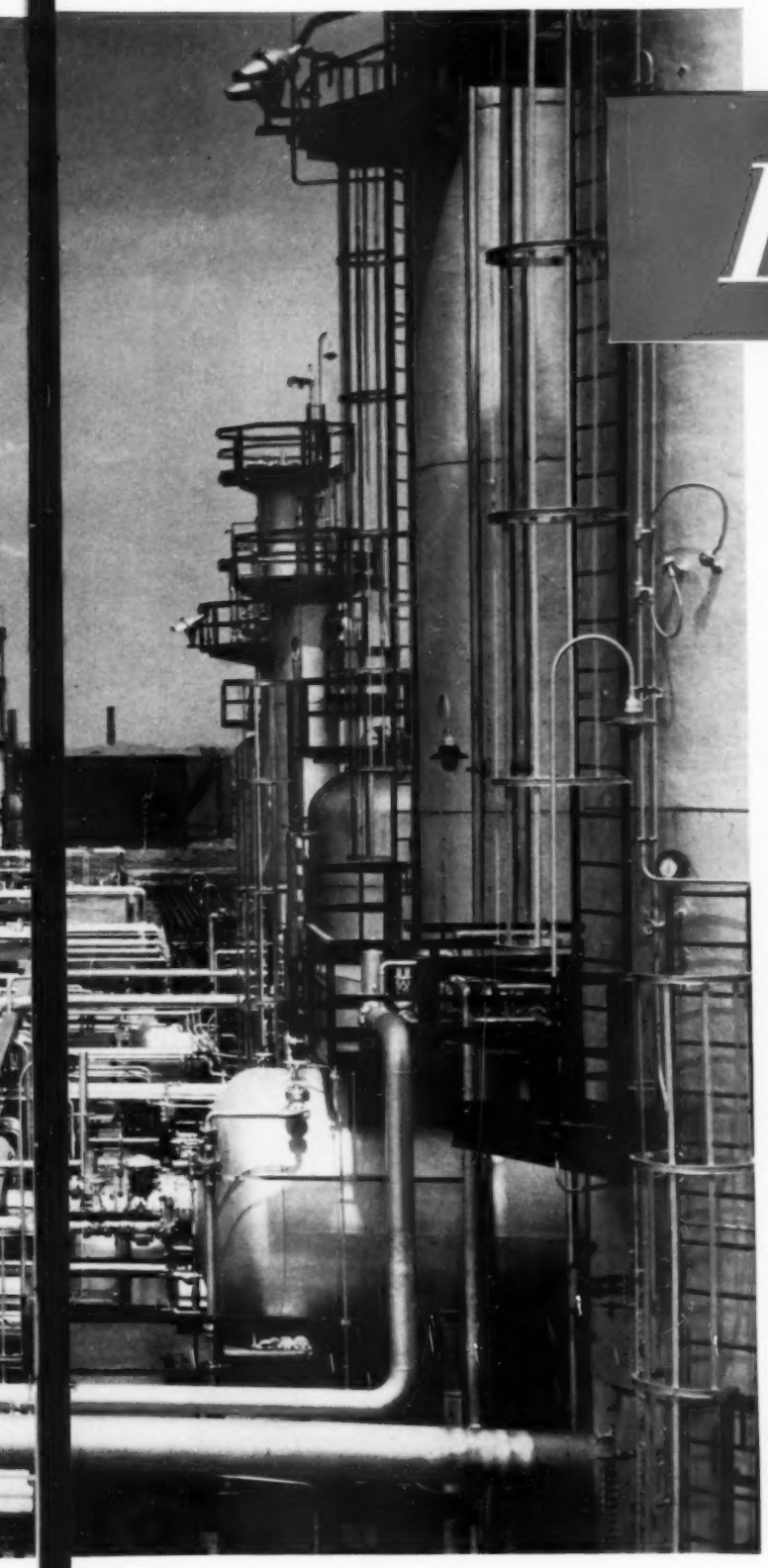
Arabian American Oil Company

DHAHRAN NEW YORK

METAL CONTAINERS LTD., 17 WATERLOO PLACE, PALL MALL, LONDON
ASSOCIATED COMPANIES OVERSEASWORKS: ELLESMERE PORT & RENFREW.



Engineering and Construction by



BRAUN

The two crude-units in the left foreground are identical twins. Each unit has its own atmospheric and vacuum stages. Each is completely self-sufficient. The combined throughput is 55,000 barrels per day.

The crude-units form a part of a complete modern refinery on the Atlantic seaboard—engineered and constructed by Braun.

The other Braun process-units built on the same construction program provide for Houdri-flow catalytic-cracking, light-ends recovery and distillation, thermal-reforming, power and steam generation.

Established in 1909, and serving the petroleum industry, the petrochemical and chemical industries, Braun provides a worldwide engineering and construction service—supplemented by a worldwide research and consulting service.

C F BRAUN & CO

Engineers

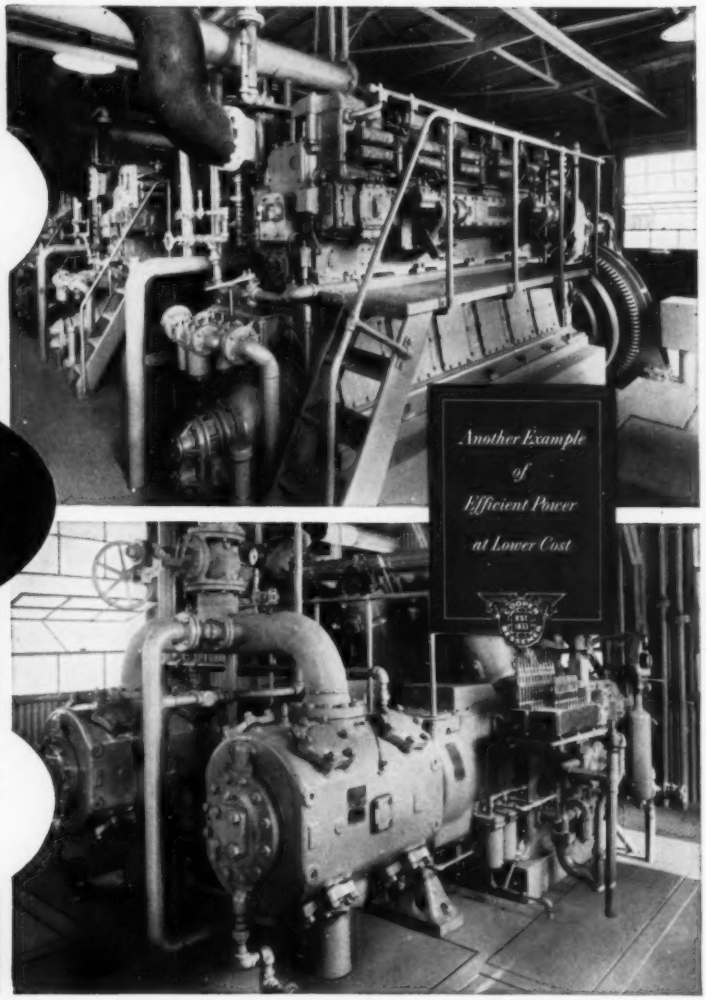
ALHAMBRA CALIFORNIA

NEW YORK • CHICAGO • HOUSTON • SAN FRANCISCO

... for efficient power generation

... for low-cost compressing

Cooper-Bessemers
ALL THE WAY



The new natural gasoline plant of the Hugoton Plains Gas and Oil Company, now operating about a year, is powered by the Cooper-Bessemer units shown above. These consist of three JS-6 540 hp gas engines driving 368 KW A.C. generators, and a 308 hp GMX V-angle compressor.

This interesting field processing plant, engineered and constructed by J. F. Pritchard & Company, serves 176 gas wells, operates without steam, and efficiently produces natural gasoline, propane, butane and iso butane. Residue gas goes into Northern Natural's system.

The three JS gas engines operate 24 hours a day, furnish all electric power required to operate the plant. Using Cooper-Bessemer's latest development in high compression operation, these modern engines attain 34.4% thermal efficiency, holding fuel consumption to less than 7400 BTU/bhp/hr.

The GMX is used as a propane refrigeration unit. And here, as in other processing services, this modern Cooper-Bessemer V-angle compressor is showing a consistent record of trouble-free, low-cost performance under continuous operation.

Whether your plans call for power generation, compressing, or both, check on the advantages you stand to gain with the latest Cooper-Bessemer developments.

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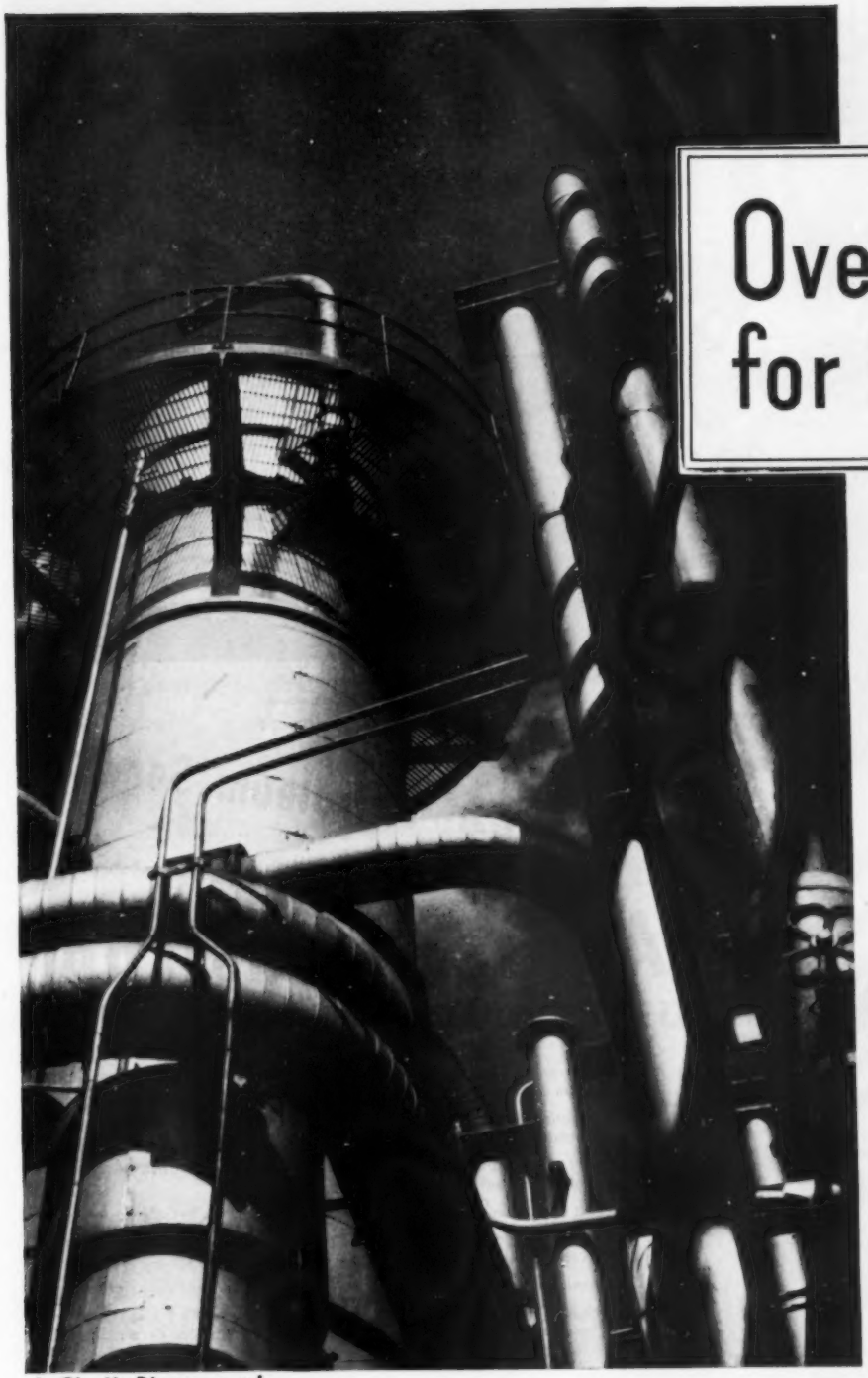

A Shell Photograph

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Kenyon provide a *complete* thermal insulation service to the oil industry, including technical advice on thermal insulation specifications, and finishes for all conditions. Supply of materials, application, supervision, on sites throughout the world.

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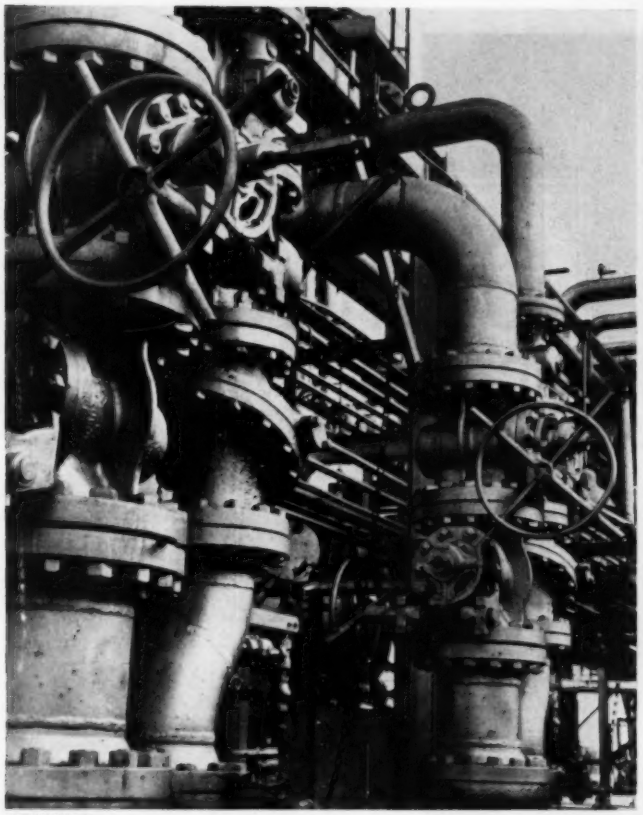
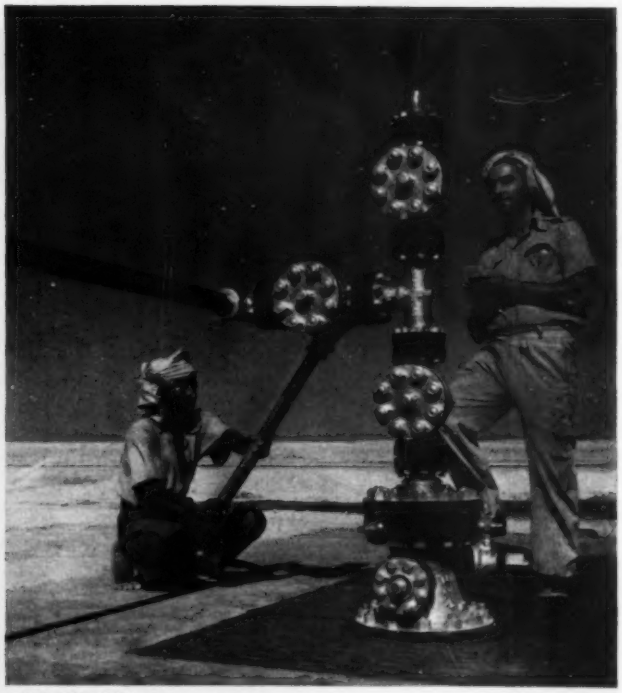


REFINING Gear-operated Audco-Nordstrom valves in Canadian Refinery



PRODUCTION Arabian oil field Christmas tree fabricated with Audco-Nordstrom valves

DISTRIBUTION Audco-Nordstrom valves control fuel hose lines in England

PIPE LINE Both wrench and gear-operated Audco-Nordstroms on Belgian pipe line

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. . . Self-adjusting tapered plug. Instead of wedging or grinding against the seat, it rotates smoothly on a film of lubricant.

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. . . Quickest operation. Only a quarter turn from fully open to fully closed.

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. . . Seat never exposed. Abrasive dirt can't get to the critical seat port areas.

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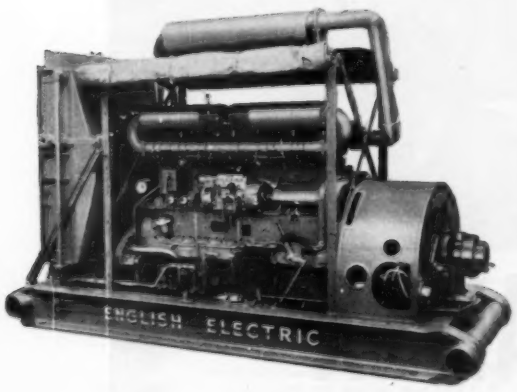

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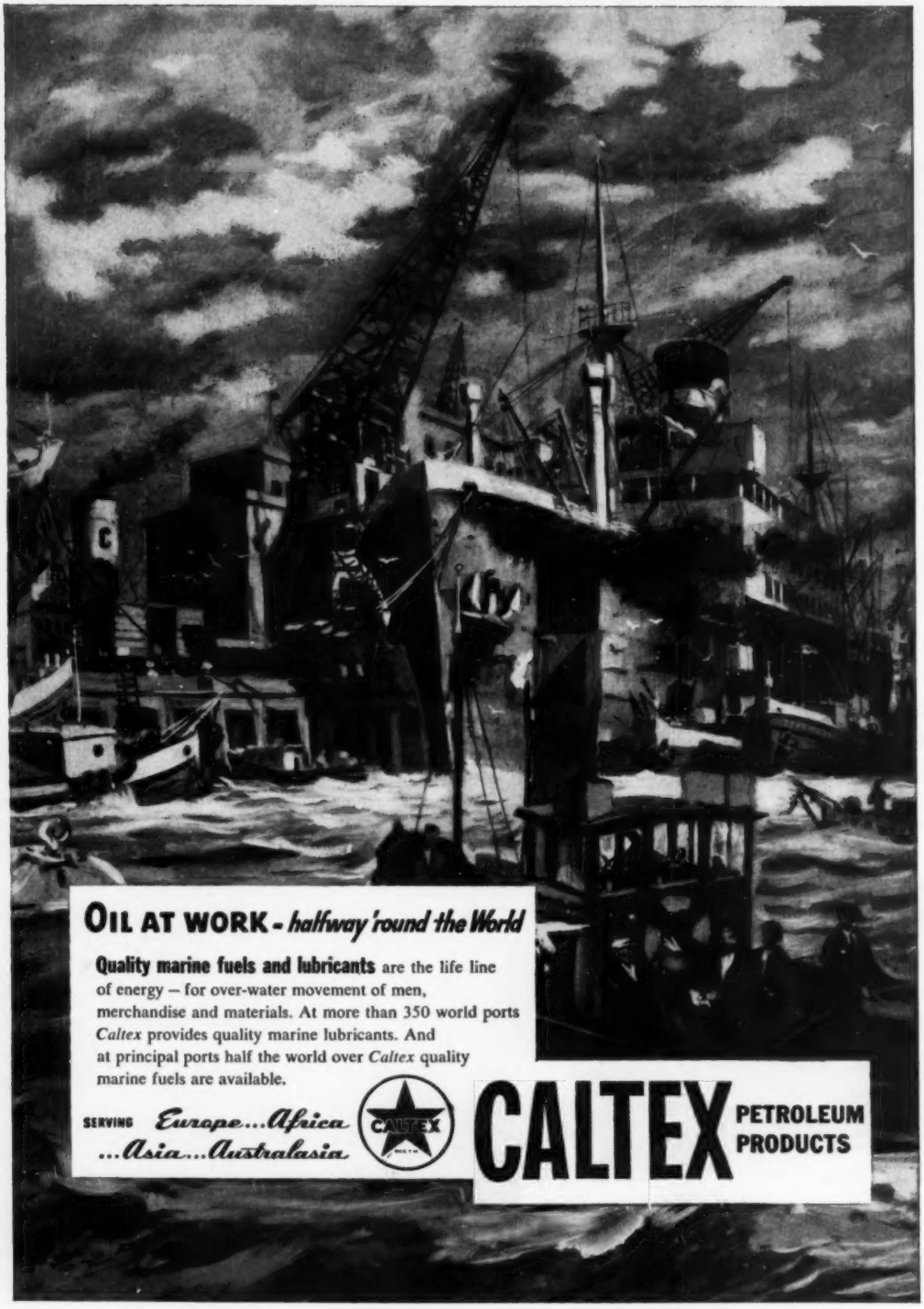
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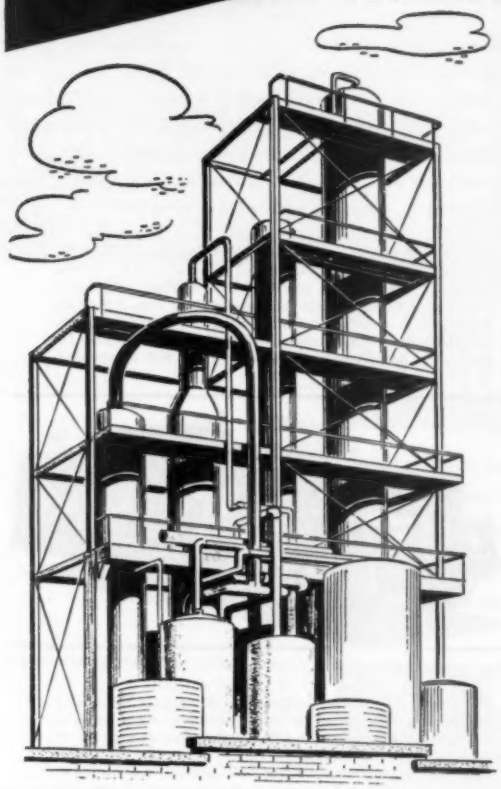
QO FURAN CHEMICALS

Here is information about Furfural itself, which will tell you why.



Handling

Furfural is a liquid at room temperature and its boiling point of 323° F. removes it from the class of substances which must be handled and stored under pressure. It is unlikely that appreciable concentrations will be built up in the air.

Explosive Hazard

Furfural has a flash point (open cup) of 135° F. and consequently introduces no problem in the way of extreme explosive hazard.

Freezing

The freezing point of furfural is −34° F. so even in severe weather, there is virtually no chance of freeze up in lines or tanks.

Toxicity

Over nineteen years experience in refineries throughout the world and thirty years of industrial experience in other processes demonstrate conclusively that furfural can be handled safely insofar as possible hazards to personnel are concerned.

Supply

In addition to the safety factors mentioned above, furfural is "safe" in the sense that it is readily available in quantity. It is produced at three different plants in widely separated locations. It is made from the non-food portion of agricultural products, such as corn cobs. Nature creates an abundant new supply of raw material each year.

Literature available

Bulletin 203 entitled "Physical Data on Furfural" contains comprehensive data, tables and curves on the physical characteristics of furfural. Bulletin 204 "Current Uses of Furfural" tells about various uses for furfural as a selective solvent, chemical intermediate, wettant and dispersant. Send your request to the nearest office below on your company letterhead.

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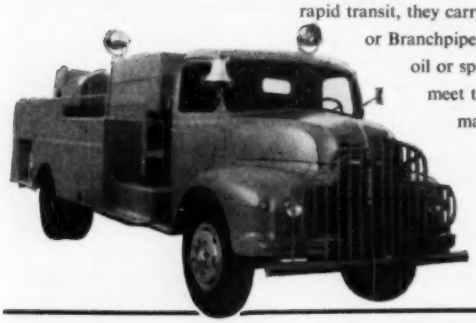
"Pyrene" Foam Tenders are universally recognised as the latest and most practical form of fire protection for Oil Tank Installations, Refineries and large Chemical Works. Designed for rapid transit, they carry their own foam compound supply, "Pyrene" Foam Generators or Branchpipes, a fire pump and all necessary equipment for extinguishing bulk oil or spirit fires. Each "Pyrene" Foam Tender is especially designed to meet the particular risks involved. The three models shown have been made to the requirements of leading Oil Companies.



With a foam tank of 500 imperial gallons capacity, this "Pyrene" Tender has an output of 5,600 imperial gallons of foam for approximately 20 minutes when connected to a hydrant. Equipment includes six "Pyrene" light-alloy Branchpipes (four F.B.10 size and two F.B.20 size), a Dennis 350/500 g.p.m. independent pump unit, hoses, collecting breechings and suction collection heads. The Leyland "Comet" chassis is powered by a 75 B.H.P. diesel engine.

This "Pyrene" Foam Tender is equipped with a tank holding 600 imperial gallons of "Pyrene" Foam Compound, two No. 20 and one No. 10 "Pyrene" Foam Generators, four F.B.10 portable Foam Branchpipes and a fire pump. This fire fighting vehicle is capable of producing 4,500 imperial gallons of foam per minute for 30 minutes without replenishment. Pump drive is by power take-off from the prime mover, a Rolls-Royce engine of 160 B.H.P.

This all-purpose Fire Fighting Tender carries not only 500 imperial gallons of foam compound, but its own "first-aid" water supply of 200 imperial gallons, six 50 lb. CO_2 cylinders, four 'Pyrene" No. 10 inline inductors, two fixed No. 10 "Pyrene" Mechanical Foam Generators and two portable No. 10 size Foam Generators. Other equipment includes First Aid Hosereel, hoses and nozzles. Pump drive is by power take-off from the vehicle's 110 B.H.P. Bedford engine.

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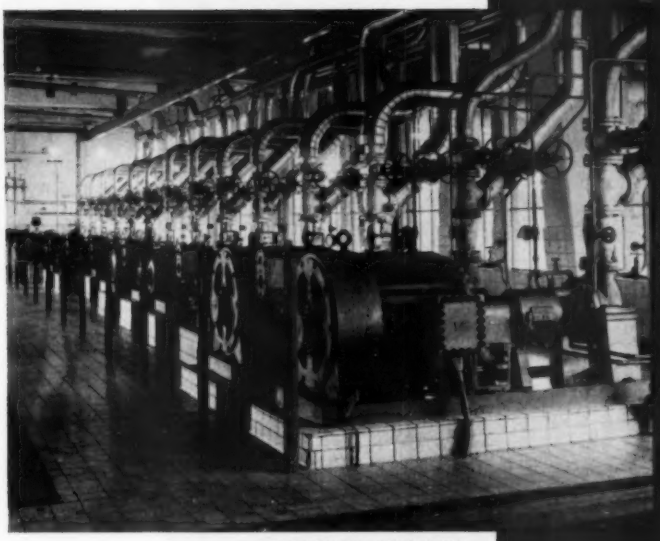

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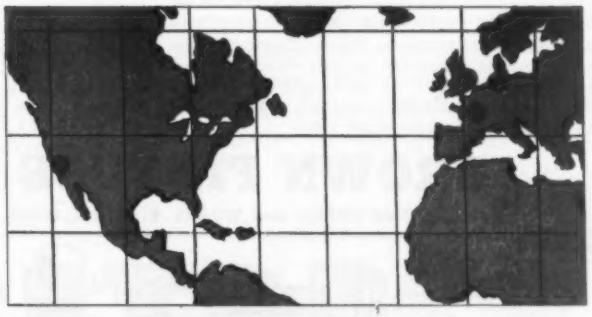

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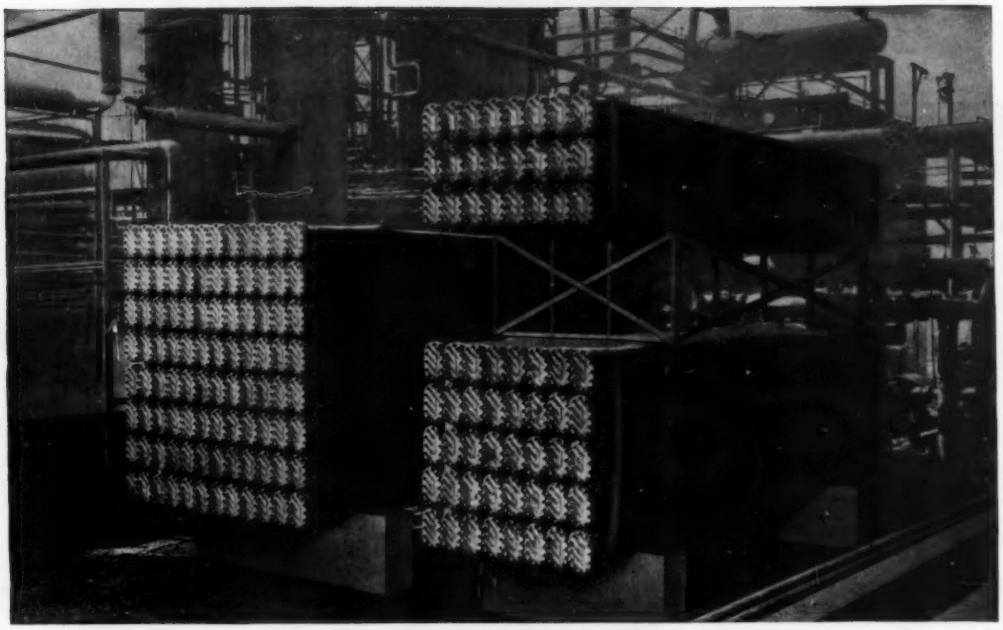

You, too, can cut costs and increase efficiency with BROWN FINTUBE *Sectional* HEAT EXCHANGERS

● A Brown Fintube Heat Exchanger for a given duty consists of Brown Fintube standard heat exchanger ***Sections*** connected in proper series-parallel arrangement . . . and gives users many advantages not available with "bundle type" exchangers . . . including

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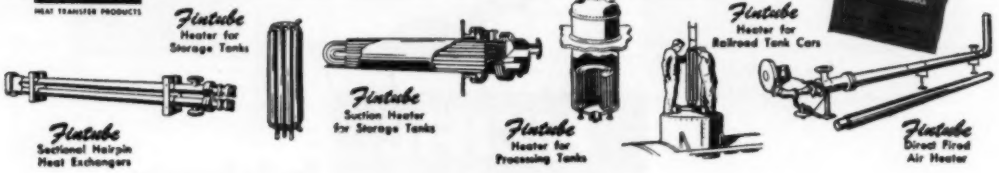

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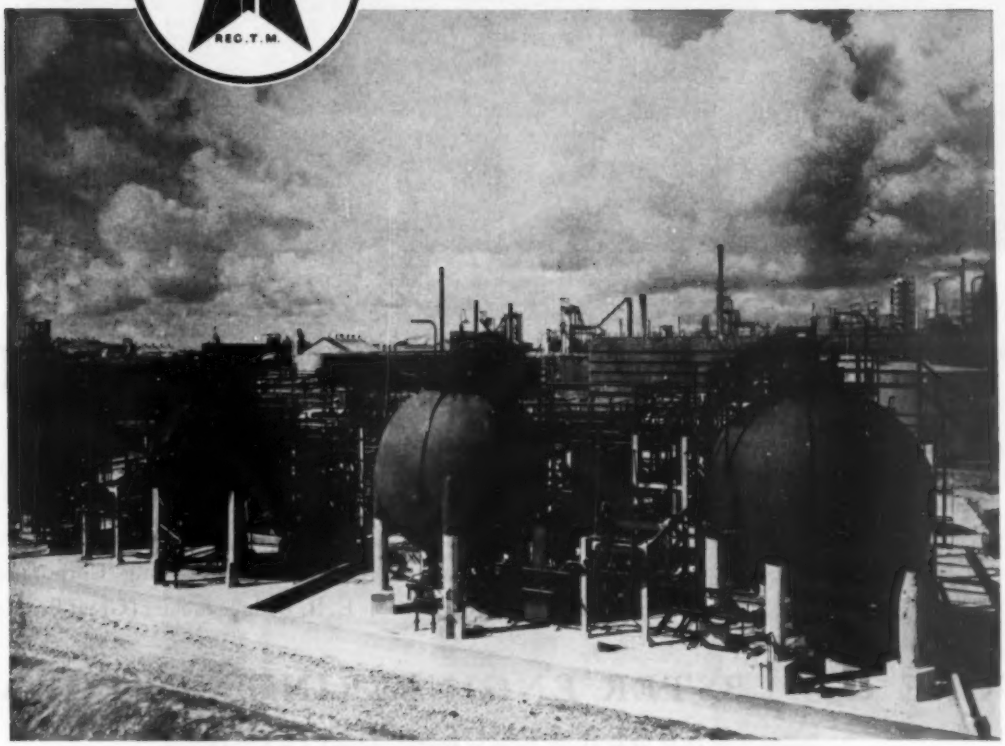

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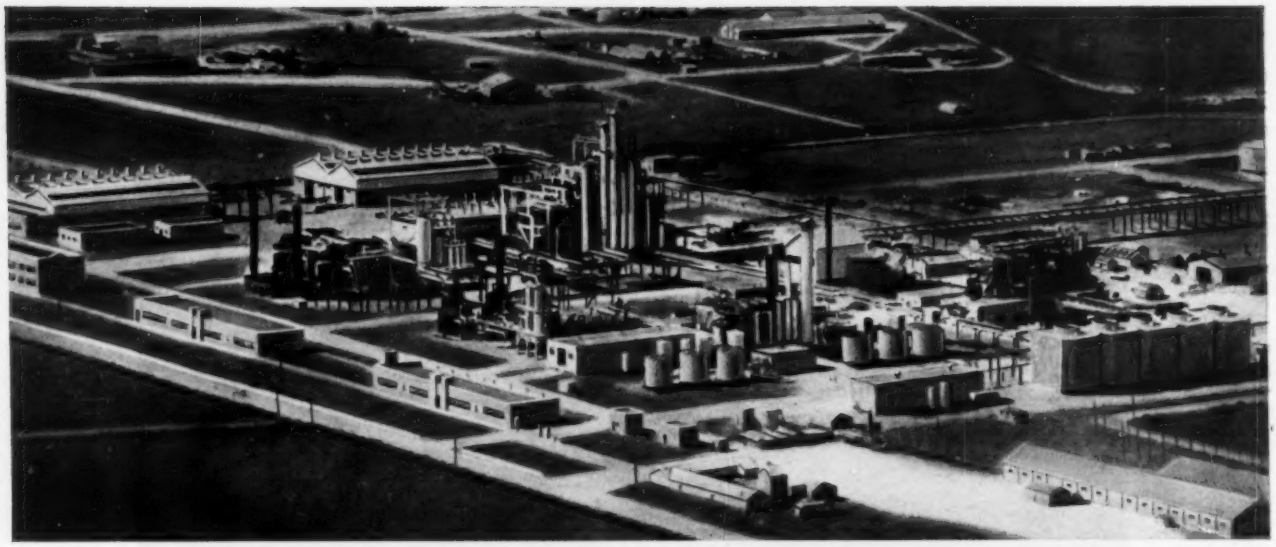

Overall View showing new facilities . . . Ethylene Plant, Ethanol Plant and Isopropanol Plant

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The British Petroleum Chemicals Ltd. plant at Grangemouth, Scotland, will supply the British Isles with a diversified line of important industrial chemicals and chemical intermediates derived from a crude petroleum stock. Design, engineering, procurement and erection supervision were performed by Stone & Webster Engineering Corporation and E. B. Badger & Sons (Great Britain) Ltd.

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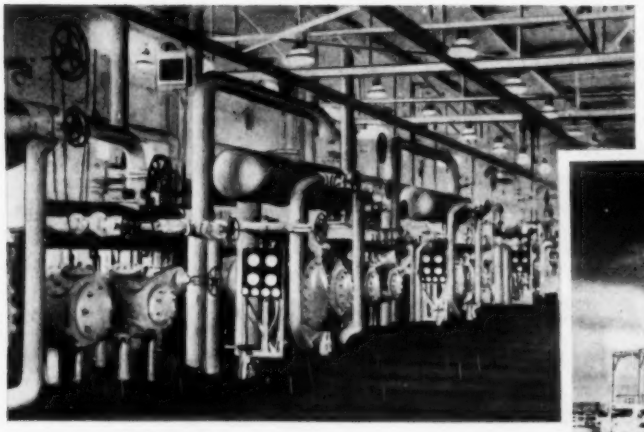
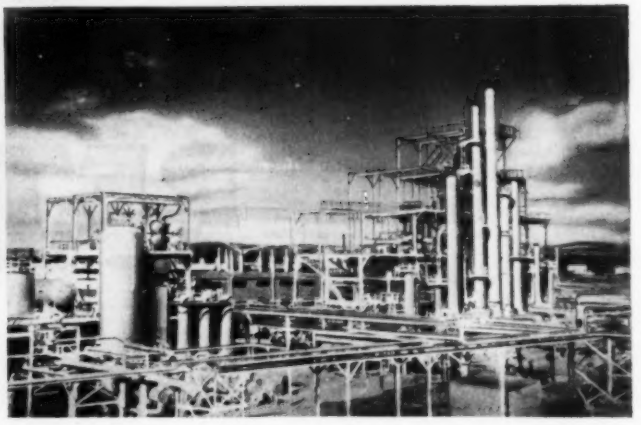


Compressor House — Interior

ETHYLENE PLANT
Cracking and Fractionating Structures



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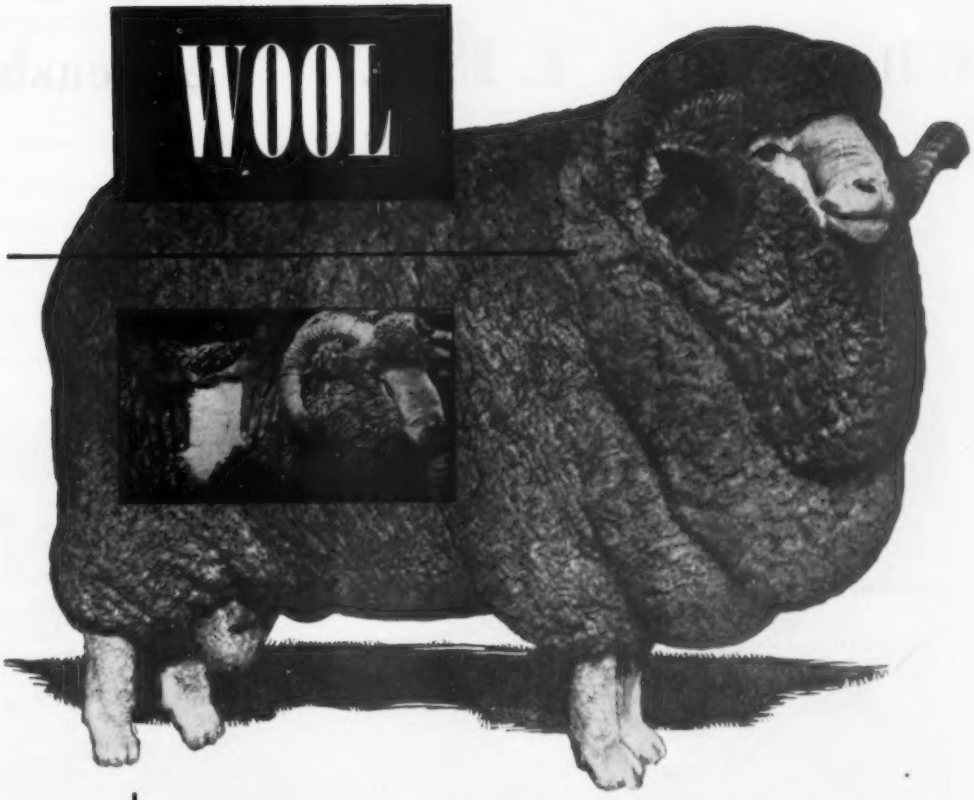

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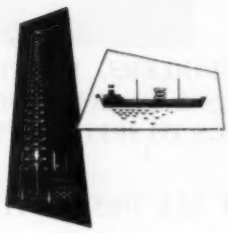

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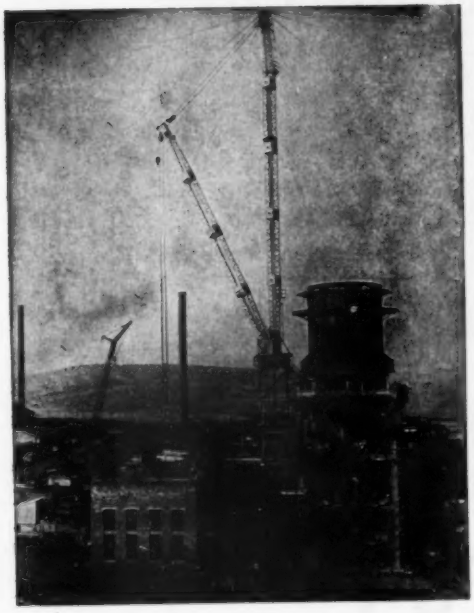
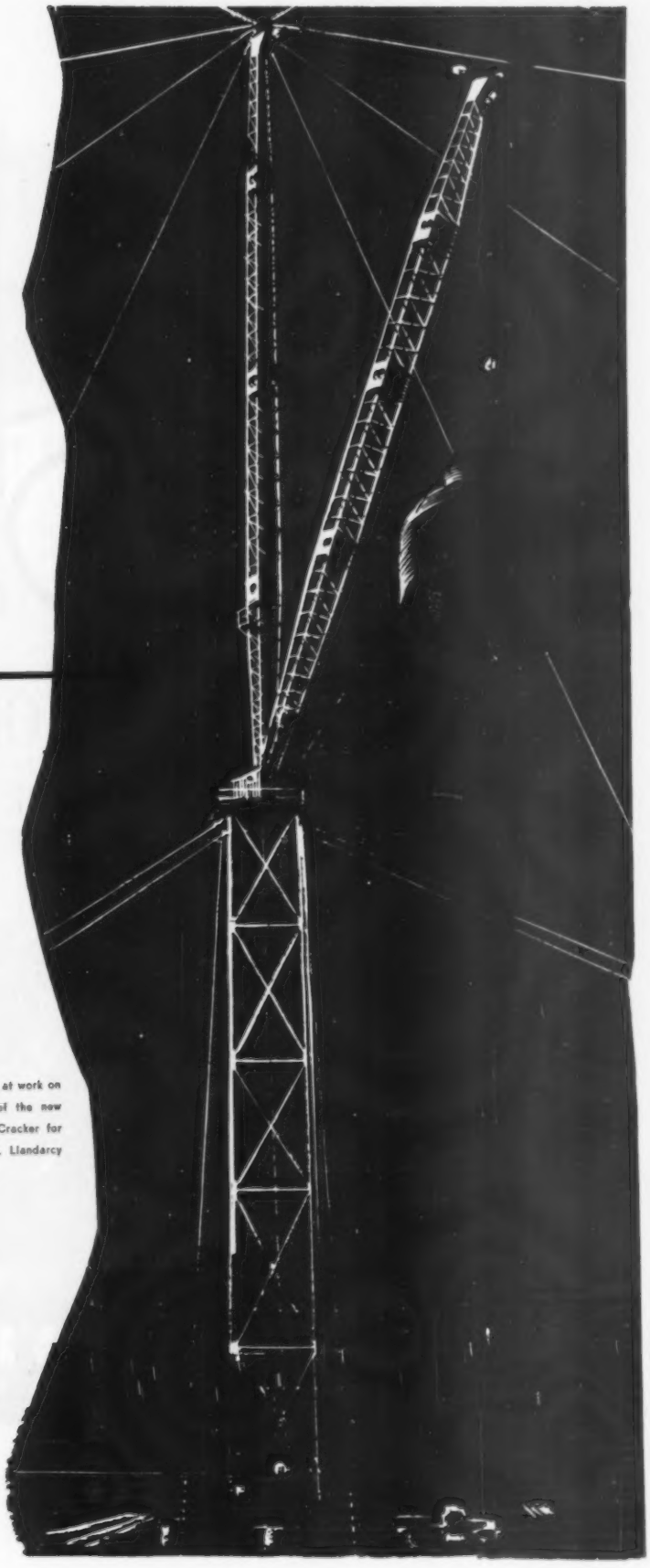
This 100 ton guy derrick, complete with winch and mounted on a 72 ft. pedestal of all our own design and construction, has a jib 133 ft. long. The top of the mast rises to more than 230 ft. This, the most powerful guy derrick made in this country, was manufactured especially for the Anglo Iranian Oil Co. Ltd., and is seen here at work on the site of a new Catalytic Cracker at Llandarcy. All Caswell cranes are tested to necessary overloads, and this crane and structure easily withstood a load of 125 tons on site.





The crane at work on the site of the new Catalytic Cracker for A. I. O. C. Llandarcy project.

MANUFACTURERS OF GUY DERRICKS • LIFTING DERRICKS • WINCHES, HAND OR POWER OPERATED • BOGIES • FOR SALE OR HIRE

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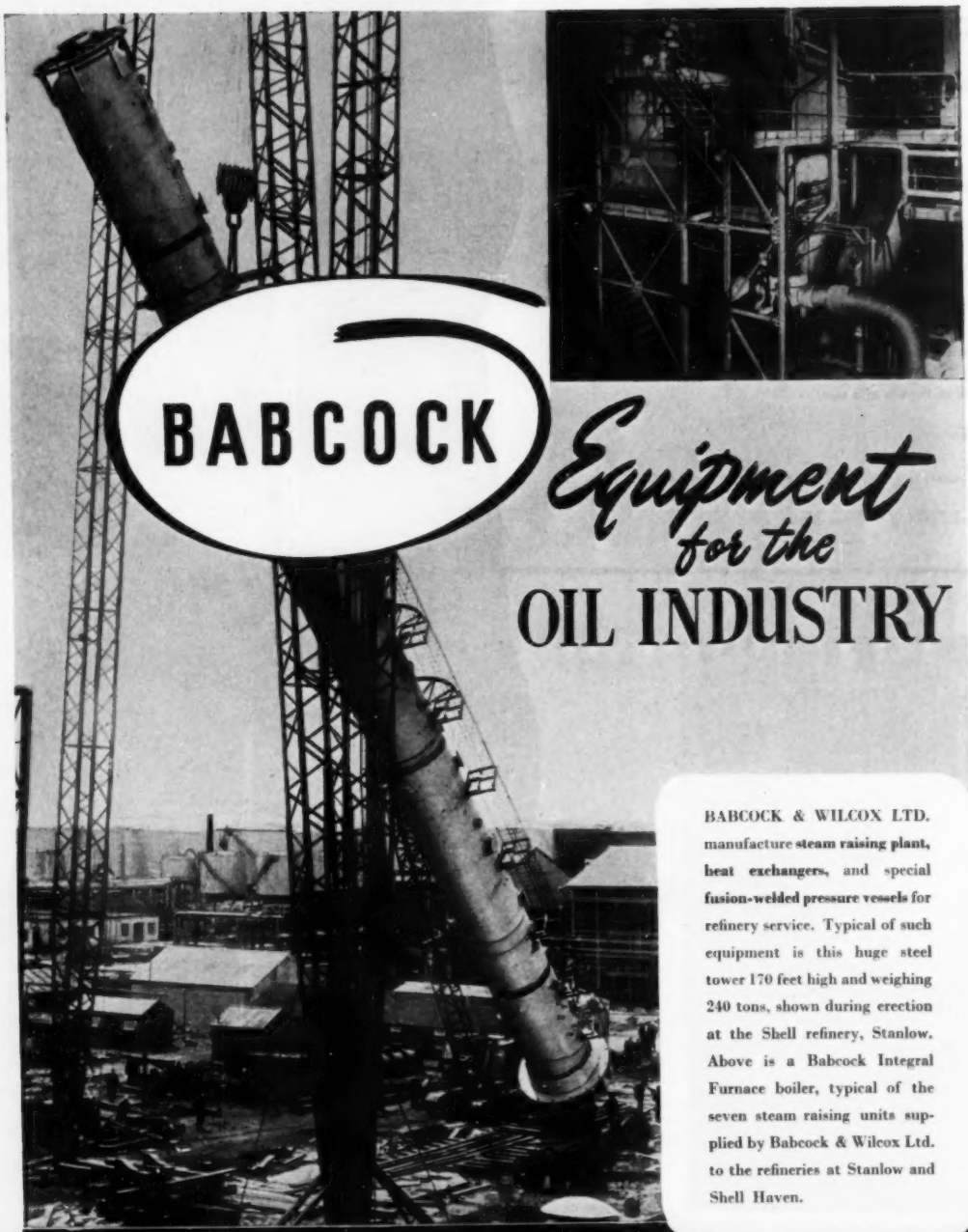

BABCOCK

Equipment for the

OIL INDUSTRY

BABCOCK & WILCOX LTD. manufacture **steam raising plant, heat exchangers,** and special **fusion-welded pressure vessels** for refinery service. Typical of such equipment is this huge steel tower 170 feet high and weighing 240 tons, shown during erection at the Shell refinery, Stanlow. Above is a Babcock Integral Furnace boiler, typical of the seven steam raising units supplied by Babcock & Wilcox Ltd. to the refineries at Stanlow and Shell Haven.

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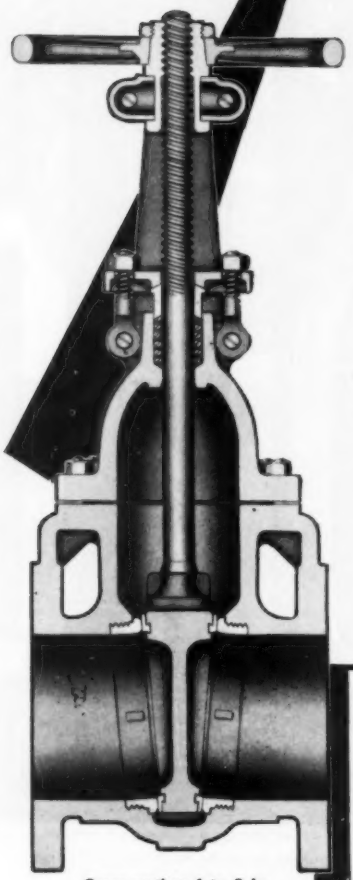
cut the high cost of corrosion

IN MANY SERVICES...WITH

CRANE *Ni-Resist*

CAST IRON GATE VALVES



Cross-section 4 to 8 in. sizes; bolted bonnet joint; flanged ends.

Here is a line of "cast iron" gate valves with a special talent for resisting corrosion, erosion and wear. Use them with safety where the strength of ordinary cast iron is adequate—in soda and sulfate pulp mill service—on creosote lines in wood treating processes—for handling sour distillates and crudes in petroleum refining—and many similar services.

Clue to the extra staying-power of Crane Ni-Resist Cast Iron Valves is in their make-up (approximately 14% nickel, 2½% chromium, and 6% copper)—and in their 18-8 Mo Alloy Steel stem and seating faces. Not to be overlooked is the fine Crane design that gives you a strong body and bonnet without excessive weight, a well-proportioned stem with precision-cut threads, a sturdy yoke, and the dependable disc-stem connection that assures smooth operation and tight seating of the solid wedge disc. Ask your Crane representative for full details, or see your Crane Catalog.

THE CRANE NI-RESIST LINE

Working Pressures:
Cold Water, Oil, or Gas, Non-shock
Screwed Valves—225 pounds
Flanged Valves—200 pounds

Available in sizes ½ to 8 in. All have solid wedge disc, with outside screw and yoke. Sizes ½ to 3 in. have clamp type bonnet joint and one-piece bolted gland. Sizes 4 to 8 in. have conventional bolted bonnet joint and two-piece bolted gland.

No. 1671 with Bolted Bonnet Joint, Flanged ends only. Sizes 4, 6 and 8 in.

No. 1670 with Clamp Type Bonnet Joint with screwed ends. Sizes ½ to 2 in. Also with flanged ends 1 to 3 in.

The Complete Crane Line Meets All Valve Needs. That's Why More Crane Valves Are Used Than Any Other Make!

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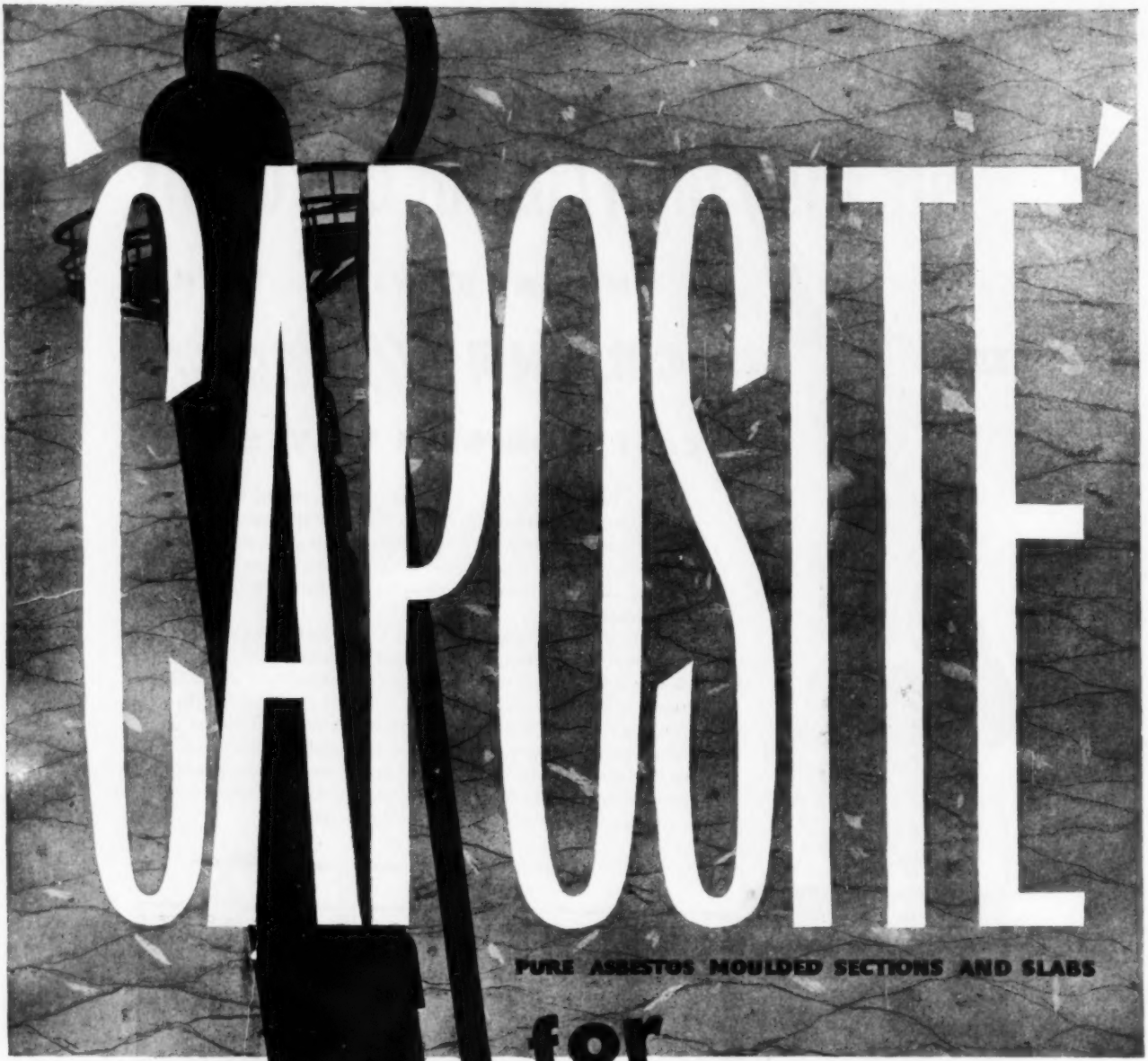

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Make the Call... We're Ready!

Petroleum refining and chemical manufacturing are industries of almost incredible superlatives. They have spent for new facilities since 1945 a sum roughly equal to total gross plant investment for all prior years. In these accomplishments, The Lummus Company—as design engineers and constructors—was privileged to play a major role.

But the years ahead are apt to make the past look puny by comparison. This year, for example, oil companies will top 1951 capital spending by over a third—chemical companies by nearly a fifth. Preliminary plans through 1955 show little or no relaxation from this rate.

Big job? Lummus is ready—a fact you may wish to bear in mind as mounting demands challenge the already-extended organizations of petroleum and chemical companies.

Rely on the quality and versatility of the Lummus staff—on the proven ability of Lummus to handle, under one contract, the functions of engineering, drafting, purchasing, expediting, inspecting, erection and initial operation.

And—as a policy statement for the record—rely on us to recognize and accept the special responsibility of handling confidential information in accordance with your own best interests and desires.

May we work together? We're ready!

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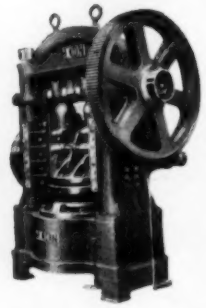
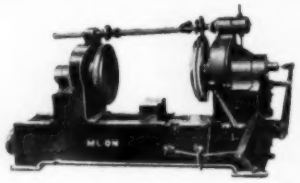
A fine seam

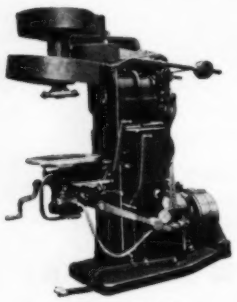
A fine seam in 14 gauge metal needs more than a needle. For this work you need a machine by Moon. In fact, for any operation in metal box or drum manufacture, you can't beat a Moon machine.



DOUBLE CRANK PRESS



DRUM FLANGER



DOUBLE SEAMER

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Regd. Trade Mark

DOUBLE CRANK PRESS MODEL V.P.

This machine is used for cutting circular blanks for drum and keg ends. Fitted with dual-sprung clutch, safety treadle and triple contact rocking key.

DRUM FLANGER MODEL G.F.

A compact Double-ended Flanger with enclosed driving and turning mechanism. Fitted with compensating device and self-centering chucks.

DOUBLE SEAMER MODEL P.R.

A Single-ended Automatic Drum Double Seaming Machine equipped with air-operated chuck guard, and air-operated clamp.

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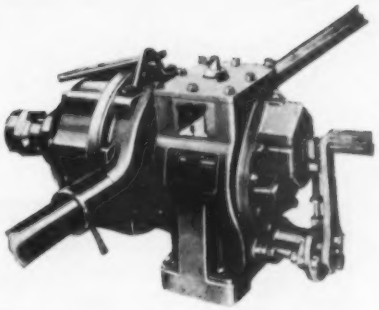
★ *Full particulars of all Holman Pneumatic Tools gladly sent on request.*



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High-efficiency tools specially designed for oil refineries, steam-raising plant, power stations, etc. Powered by vane-type air-motor, and built to endure heavy shock loads. Full range of square chucks.

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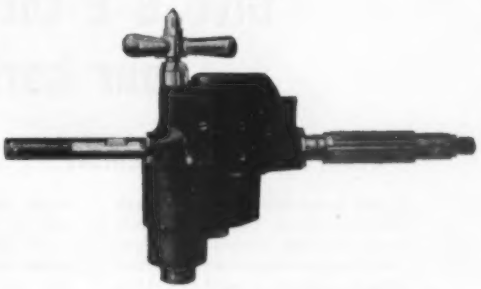
New Series—with interchangeable motors. Complete range of precision grinding and heavy-duty tools for internal grinding, cleaning castings, polishing, buffing, scaling, fettling, etc. Simple, efficient, smooth-running, quiet. Straight and grip handles supplied. The range includes **Rotobrushes.**



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New Series — with interchangeable motors. Simply constructed, robust and free from vibration. Automatic lubrication. Reversing mechanism gives equal power in either direction, and a stalled drill can be restarted at once.

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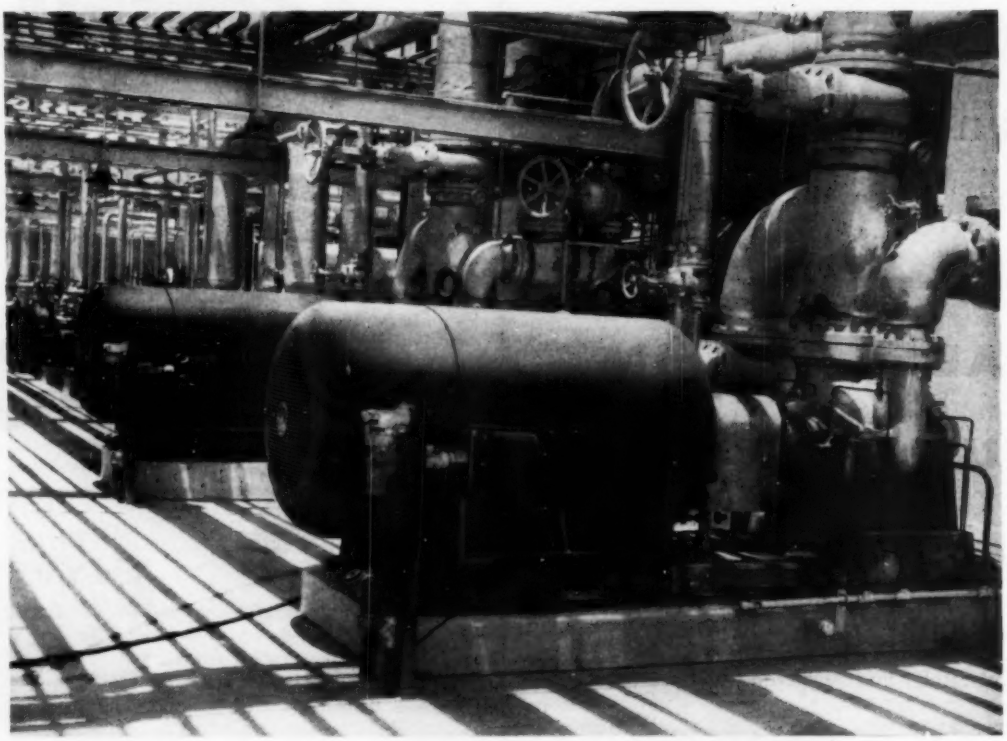

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Expect maximum safety and peak efficiency from General Electric totally-enclosed motors . . . wherever you put them to work in your refinery, indoors or outdoors. After years of research and testing, G-E now offers the most extensive line of standard and explosion-proof types available today. In the widest variety of types and sizes, these motors serve dependably in atmospheres containing: gasoline, petroleum, naphtha, alcohols, acetone, solvent vapors, natural gases, etc.

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G-E explosion and dust-explosion-proof motors are built specifically for use in these hazardous locations. Carefully machined flame paths, non-sparking Textolite fan insure this safety.

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GENERAL ELECTRIC

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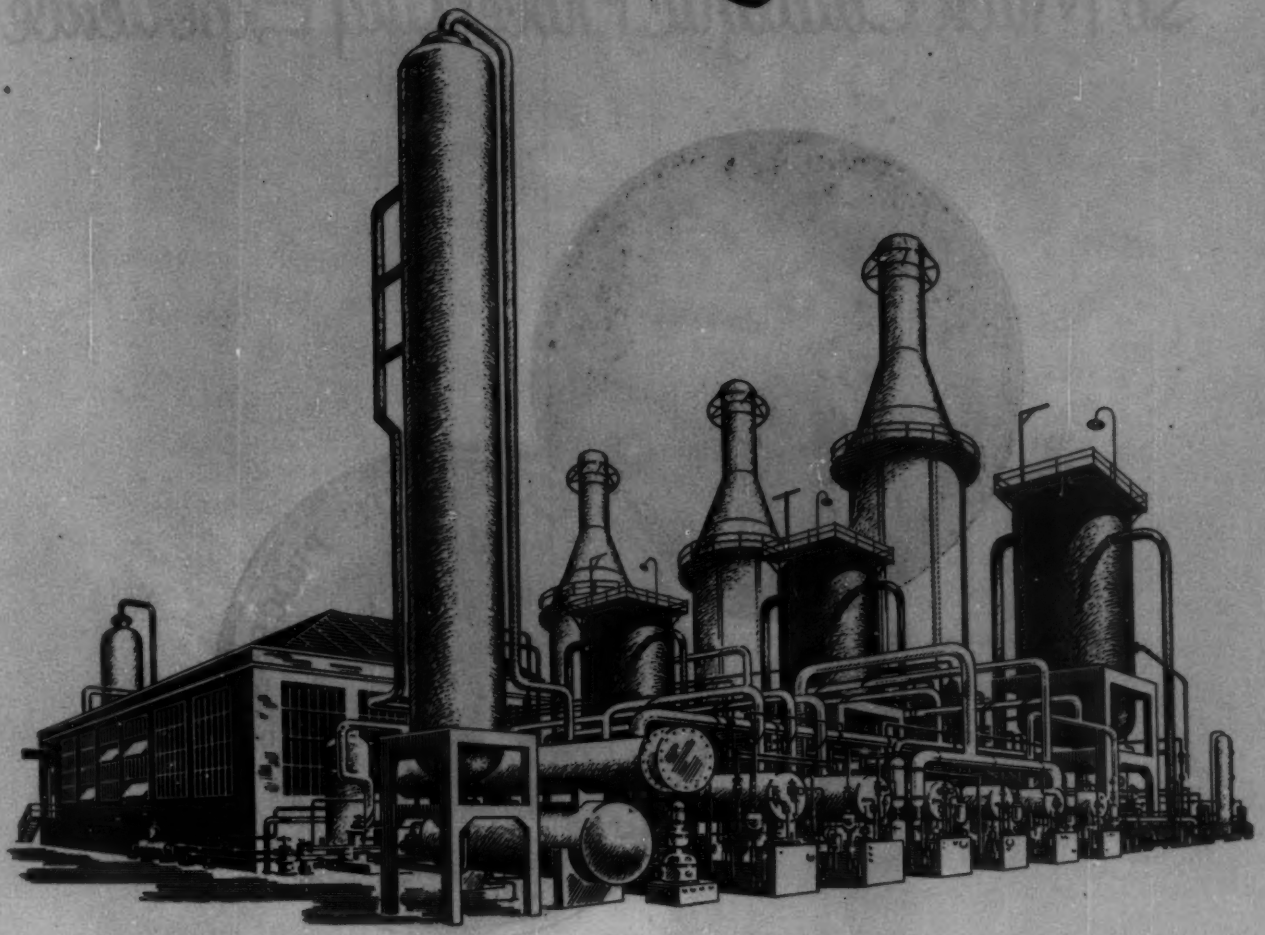
Nowhere Else Can You Acquire So Much Catalytic Processing Experience

- First to make catalytic cracking commercially practicable—Houdry pioneered its development more than a quarter-century ago.
- First to employ the gas-lift principle for transporting pelleted type catalysts—Houdry made possible the modern moving-bed units.
- First to introduce catalytic methods *internationally*—Houdry has licensed more than 90 catalytic cracking units in the major oil-producing areas in the world.
- First to make catalytic research a full-time job—Houdry maintains the finest independent research organization in the petroleum industry.
- First in the field of catalytic cracking for the production of automotive and aviation fuels—Houdry concentrates on catalytic processes applied to petroleum hydrocarbons:

Catalytic cracking
Catalytic reforming for upgrading naphthas
Aromatization of petroleum hydrocarbons
Desulphurization of motor gasoline and refinery gases
Removal of color bodies and gum-forming constituents from raw motor fuels
Conversion of olefins in aviation fuels
Production of butadiene from butane
Production of butylene from butane
Production of styrene from ethyl benzene

Houdry tells you about the new HOUDRIFLOW and HOUDRIFORMING processes on the two following pages →

Nowhere Else Can You Get Such



For Maximum Yields of Aromatics or Highest Octane Fuel...

HOUDRIFORMING—*Catalytic Reforming Process*

TWO PLANTS IN CONSTRUCTION

You can rely on HOUDRIFORMING to *do* what we say it will. In pilot operations HOUDRIFORMING has produced 100-octane gasoline from typical low-octane naphthas—*and* also converted 100% of naphthenes and high volumes of paraffins to aromatics!

Check these advantages—no other catalytic reformer combines them:

Maximum yields of benzene, toluene, xylenes
Maximum yields of high octane fuels
Complete flexibility for upgrading motor gasoline or producing aromatics—at low pressure

YOUR BARREL OCTANES FROM HOUDRIFORMING ARE NOT GUESSTIMATES: WE GUARANTEE THEM!

If you want higher yields of aromatics and high-octane gasolines from petroleum fractions, investigate HOUDRIFORMING. Our Design and Research organizations will adapt this new reforming process to your requirements. Send today for full details of HOUDRIFORMING.

Catalytic Processing Efficiency

For Highest Product Yields

at Lowest Costs . . .

HOUDRIFLOW—*Catalytic Cracking*

Here is the most advanced of the modern catalytic cracking processes. Houdry pioneered the technique and only HOUDRIFLOW brings you this combination of benefits:

Highest product yields
Lowest initial investment
Lowest maintenance cost
Lowest operating cost
Maximum operating flexibility
Longest experience in catalytic cracking
Proved operation on all types of catalysts
Plant-wide technical service
All HOUDRIFLOW *research and development*

HOUDRIFLOW permits operation in any desired range of catalyst-oil ratios. Efficient purging of the spent catalyst gives highest yields of liquid products from heavy stocks. Compactness permits installation in small ground area.

10 HOUDRIFLOW units are already in successful operation. Others are in construction here and abroad. Our Design and Research organizations will help you adapt this modern cracking process to your needs. Send for full information regarding HOUDRIFLOW.

HOUDRY

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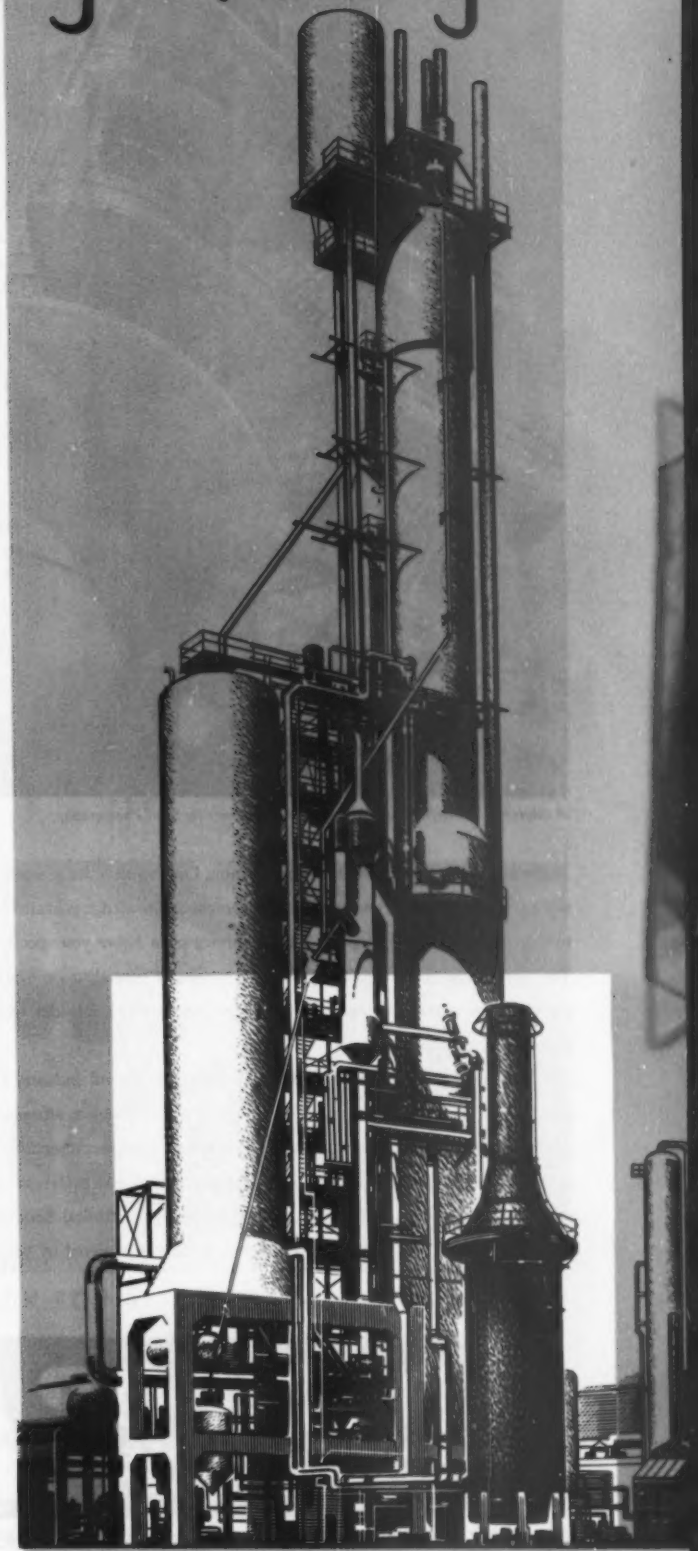
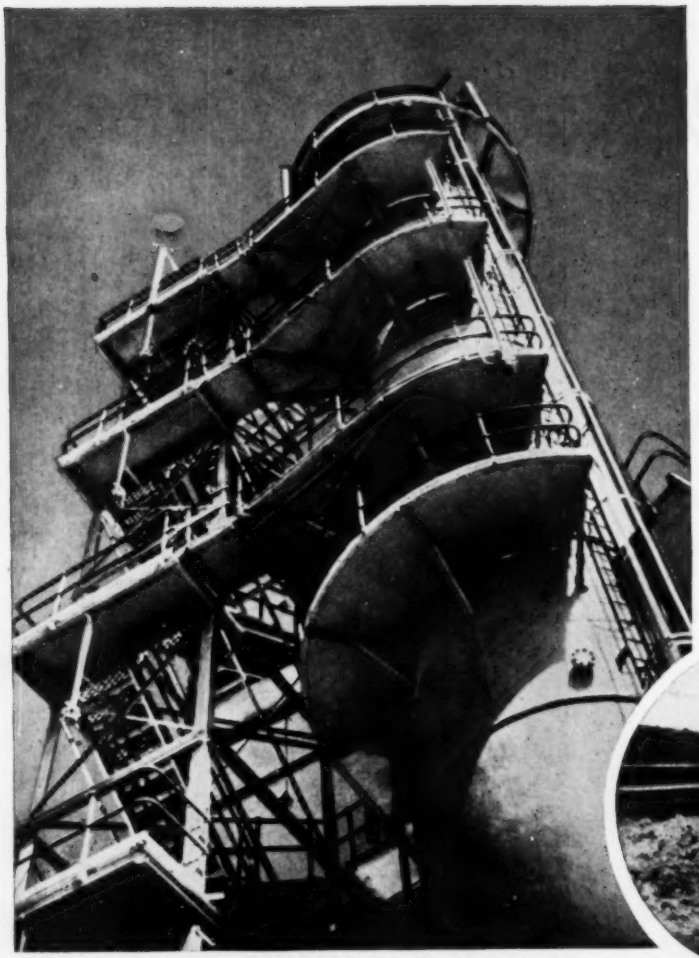
PIONEER IN CATALYTIC PROCESSES

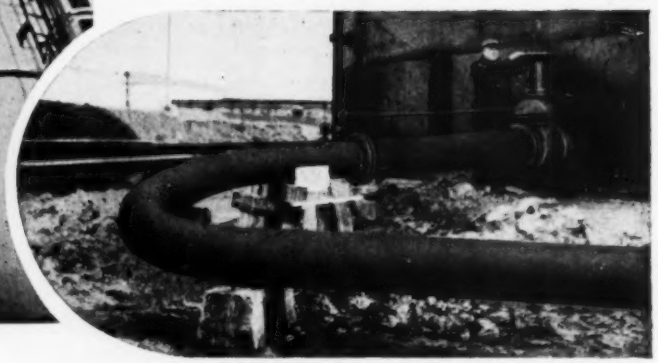




A column of the Reforming Unit at Cardon Refinery (a Shell Photograph)

* ***DUNLOP EQUIPMENT is installed at oilfields and refineries throughout the world.***

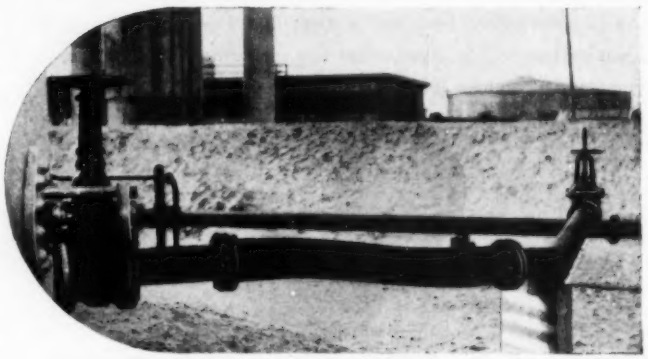
Service comes first–



Dunlop Oil Suction and Discharge Hose bridging the gap between pipe line and storage tank. This type incorporates high-quality, hard-wearing, oil resistant synthetic rubber compounds, and is suitable for the severest conditions

In the application of rubber to oil production, Dunlop have long, world-wide experience and this accumulation of practical knowledge is available to you through the Dunlop Technical Service even *before* you specify. You can obtain the skilled advice of this bureau of specialists on every aspect of equipment selection, from the first moment you consider new or replacement materials.

The wide range of Dunlop products developed for the oil industry is listed at the foot of this announcement. If you have a problem affecting this type of equipment, please contact your nearest Dunlop representative or distributor who will provide every assistance. Or, if you prefer, send your enquiry to Dunlop's Manchester address below. Technical Service advice is freely and gladly given, and no obligation is incurred by you



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OIL SUCTION & DISCHARGE HOSE, SLUSH PUMP HOSE.
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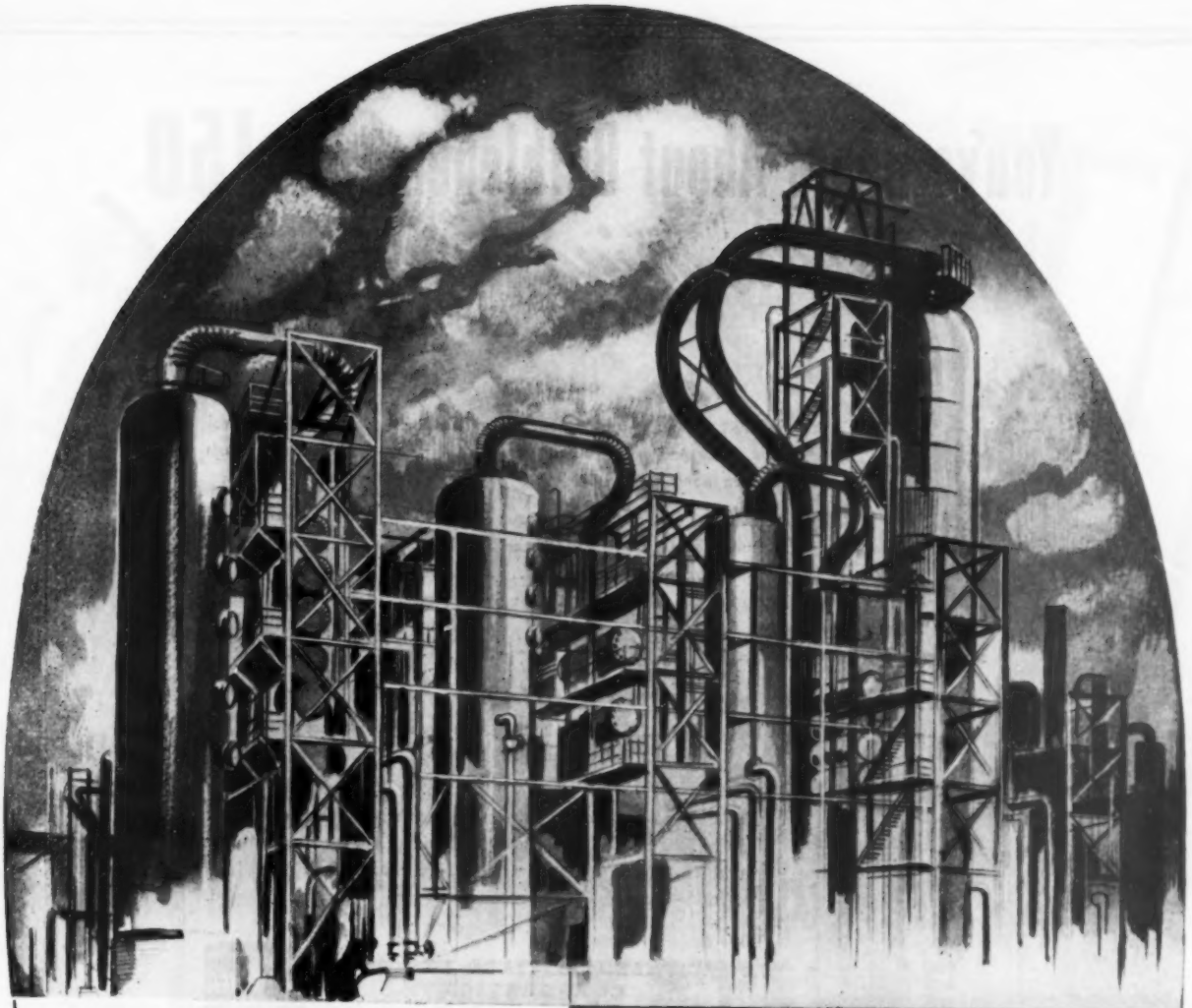
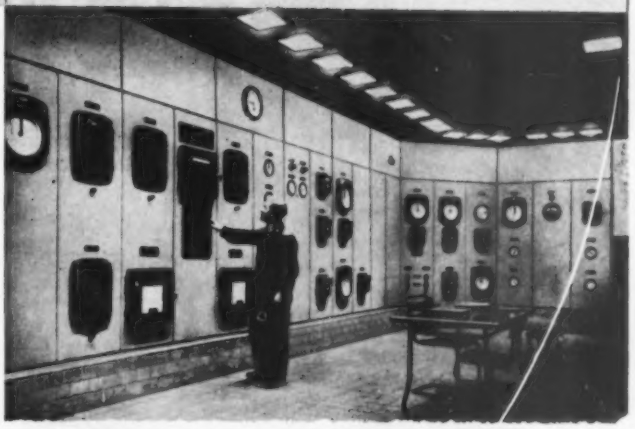


THE WORLD'S FIRST

OIL REFINERY PLANT TO BE COMPLETELY

CONTROLLED ELECTRONICALLY

The new SO_2 Kerosene Extraction Plant at Llandarcy is the world's first electronically controlled refinery unit to be placed on stream. Control is effected automatically by Evershed Process Controllers operating on the Evershed Electronic system which eliminates time lag and facilitates control over almost unlimited distances. Write for details of the various instruments installed at Llandarcy—flowmeters, level and pressure transmitters, process controllers and electro-pneumatic relays.



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EVERSHED & VIGNOLES LTD LONDON • W4 • ENGLAND

TELEPHONE CHISWICK 3670 • TELEGRAMS MEGGER CHISK LONDON

You've Heard About Bethlehem's H-150 ...you're going to hear more!

Bethlehem's H-150, a pump for light rotary work, has been in the family for several months now. Long enough for almost everybody to hear about it. Long enough for drilling men to buy it and try it.

Out in the field, the only real proving grounds, the H-150 has done a swell job—for it's a sturdy, tough little unit with features reflecting the best in slush-pump engineering. Just take a look at these points: Complete oil-bath lubrication... pulley extension both sides... all-steel fluid end... API metal ring gaskets on valve covers, stuffing box housing flanges, discharge flanges, strainer housing flanges... telltale hole protecting fluid end from washouts if packing fails... alloy-steel gear made from rolled seamless forging... alloy-steel pinion... roller bearings throughout.

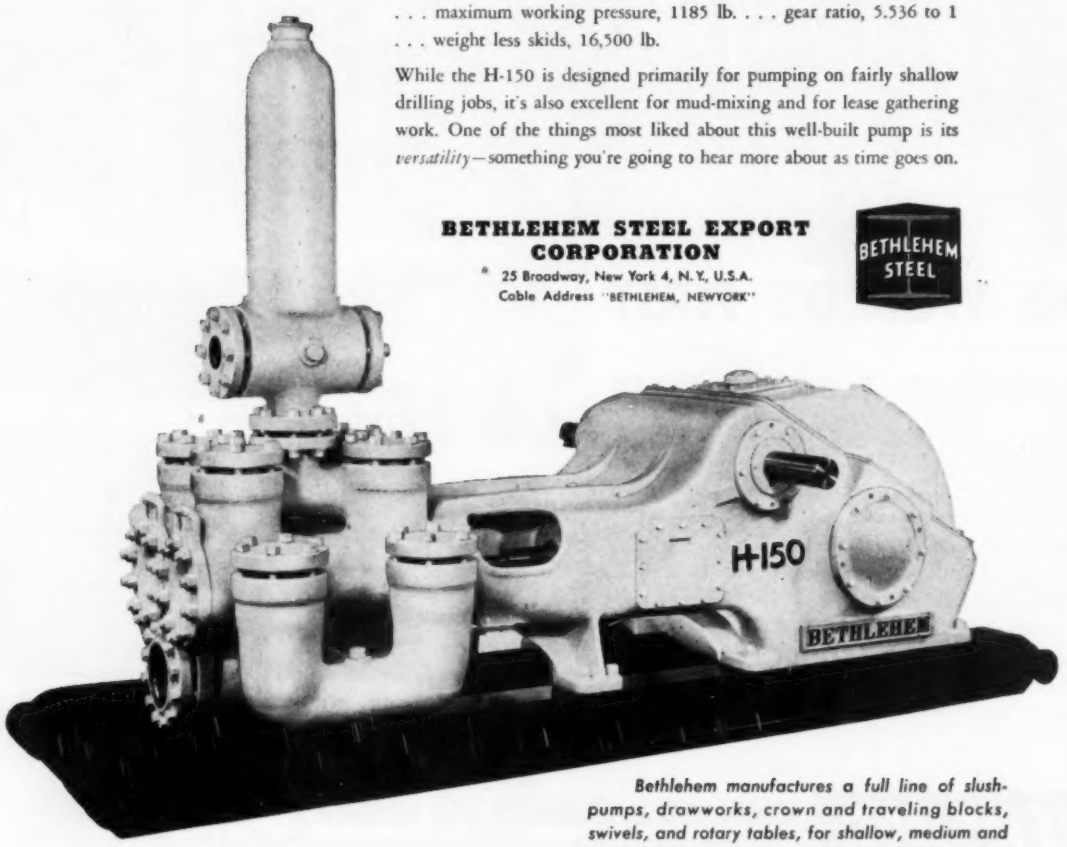
Specifications? Here they are:

Bore, 7¼ in. . . . stroke, 12 in. . . . maximum input bhp at 70 rpm, 191 . . . maximum working pressure, 1185 lb. . . . gear ratio, 5.536 to 1 . . . weight less skids, 16,500 lb.

While the H-150 is designed primarily for pumping on fairly shallow drilling jobs, it's also excellent for mud-mixing and for lease gathering work. One of the things most liked about this well-built pump is its *versatility*—something you're going to hear more about as time goes on.

BETHLEHEM STEEL EXPORT CORPORATION
25 Broadway, New York 4, N.Y., U.S.A.
Cable Address "BETHLEHEM, NEWYORK"

BETHLEHEM STEEL



Bethlehem manufactures a full line of slush-pumps, drawworks, crown and traveling blocks, swivels, and rotary tables, for shallow, medium and deep drilling; and, for production work, pumping units in a wide range of sizes and types.

FOR MORE RAPID LAYING OF PIPELINE

The production and piping of oil has been said to depend upon compressed air more than any other single form of power. Compressed air from the first moment of site preparation . . . compressed air for trenching and rock drilling in the extension of the vital pipelines . . . compressed air for the multitudinous items of maintenance. In applications such as these, three factors must outweigh all others — outstanding reliability in compressors to ensure a continuous supply of air . . . the highest degree of efficiency in compressed air tools to ensure the economical use of that air . . . and a really extensive range of equipment to provide a tool for every purpose. Because CP meets these requirements in full measure, it certainly pays to . . .

CALL IN CONSOLIDATED

CONSOLIDATED PNEUMATIC TOOL CO. LTD. – LONDON & FRASERBURGH

Offices at Glasgow • Newcastle • Manchester • Birmingham • Leeds • Bridgend • Belfast • Dublin • Johannesburg
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FROM FILE TO FIELD

. . . IN ONE STEP

IMMEDIATE ERECTION OF STANDARD A, B, and C * PLATFORMING UNITS

NO DELAYS . . . NO WAITING FOR DESIGN DRAWINGS

This is big news for the refiner who needs Platforming . . . and in a hurry!

Procon can erect Platforming units of * 600, 1000, and 1500 barrel per day design capacities from drawings already on file. This means no time out for detail design—no extended interval between contract and construction.

Actual capacities of these Standard units will vary according to refiner's feed stocks and method of operation, but the range of sizes permits the refiner to choose the capacity best suited to his individual requirement.

This file-to-field service is the answer to fast, economical construction and enables the refiner to take the shortest route to profitable on-stream production with the widely accepted Platforming process.

PROCON

PROCON *Incorporated*

PROCESS CONSTRUCTION

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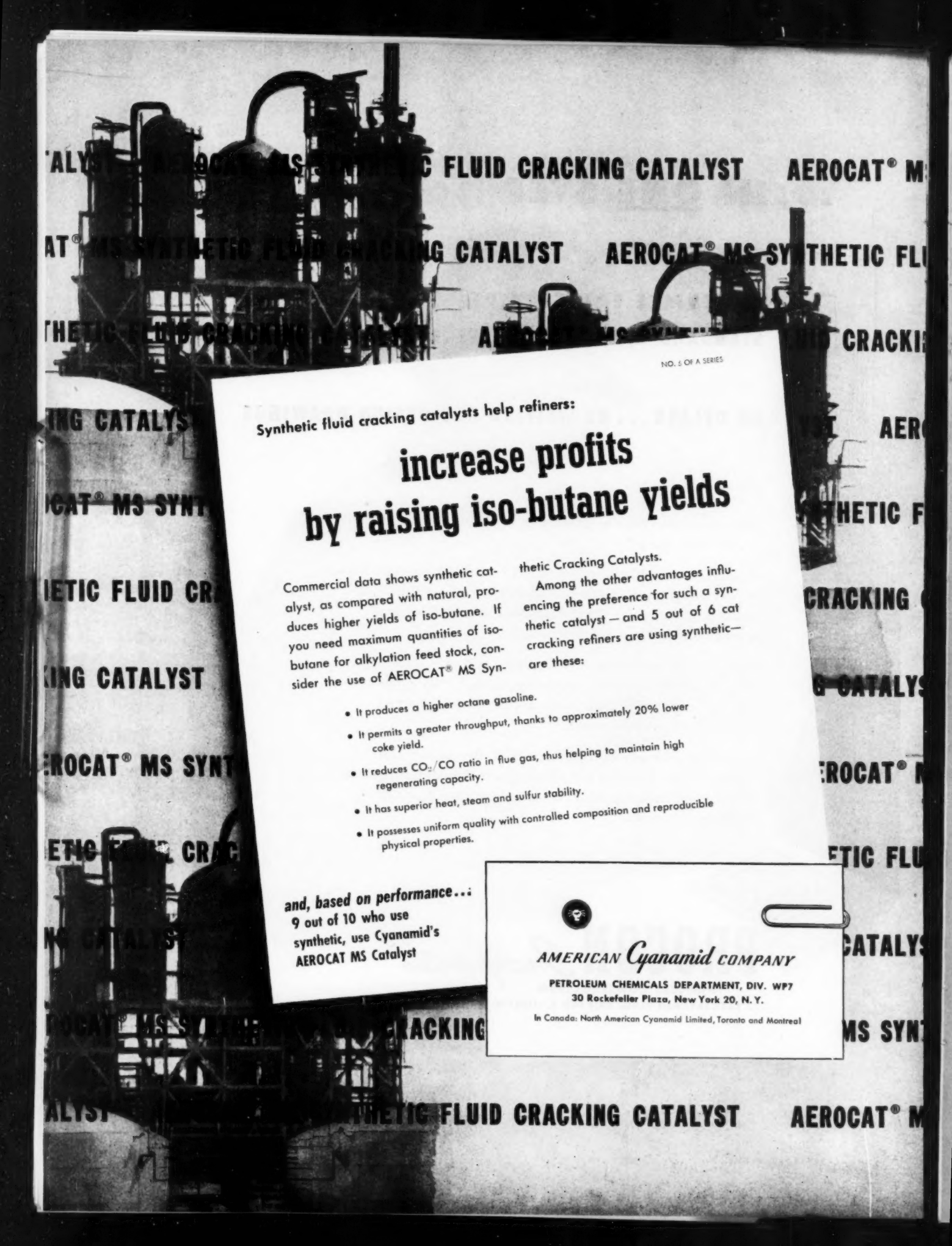

NO. 5 OF A SERIES

Synthetic fluid cracking catalysts help refiners:

increase profits by raising iso-butane yields

Commercial data shows synthetic catalyst, as compared with natural, produces higher yields of iso-butane. If you need maximum quantities of iso-butane for alkylation feed stock, consider the use of AEROCAT® MS Synthetic Cracking Catalysts.

Among the other advantages influencing the preference for such a synthetic catalyst — and 5 out of 6 cat cracking refiners are using synthetic — are these:

- It produces a higher octane gasoline.
- It permits a greater throughput, thanks to approximately 20% lower coke yield.
- It reduces CO_2/CO ratio in flue gas, thus helping to maintain high regenerating capacity.
- It has superior heat, steam and sulfur stability.
- It possesses uniform quality with controlled composition and reproducible physical properties.

and, based on performance...
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MONA PALMER
Publisher

E. W. MAYO
Editor

J. C. CHATFIELD
Managing Editor

W. E. ANDERSON
Production Manager

LEONARD RUBEN
Art Director

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BRANCH OFFICES

LONDON
G. L. Fotherstonhaugh, St. Paul's Corner, Ludgate Hill, London E.C. 4
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NEW YORK 36
E. L. Townsend, Eastern Advertising Manager,
2 West 45th Street
(Tel. MUrray Hill 2-7333)

TULSA 3
O. F. Cozier, Mid-Continent Advertising Manager, 515 McBirney Bldg.
(Tel. 4-5555)

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CONTENTS

73 Refining Becomes a Global Industry
74 Kent Refinery Will Add 4,000,000 Tons to Britain's Processing Capacity
78 Air Pollution a Public Relations Problem for All Urban Refiners
84 French Refinery Output Exceeds National Requirements
88 Factors in the Design of Refinery Electrical Distribution Systems
90 Broad Construction Activity Makes Refining a World Wide Industry
94 Cities Service Operates First Orthoflow Cracker in United States
96 German Refineries Fully Cover Domestic Demand: Ruhr Becomes Refining Center
100 Cat Reactor Replaced During Normal Turnaround
102 U. S. Refiners Raise Capacity to Meet Defense Requirements
106 Houdriflow Catalytic Cracking: A Progress Report
110 Coryton: Vacuum Oil Company's New Refinery
112 Italy's Refineries Exceed Demands for White Products but Problem of Fuel Oil Remains
115 Oil Refineries of the World
128 High Alumina Cement in Oil Refineries
148 Air-Water Cooling Unit Saves Water at West Texas Gasoline Plant
164 Advertiser's Index

THIS MONTH'S COVER

During Oil Progress Week last October, Gulf Oil Corp. dedicated the largest fluid cat cracker in the world at Port Arthur, Texas. The unit, as pictured on this month's cover, has a charging capacity of 60,000 b/d. Its throughput is 20 percent greater than any other unit operating. Construction was by the M. W. Kellogg Co. Color plates are reproduced through the courtesy of Donald C. White, editor of The Orange Disc, Gulf's house magazine.

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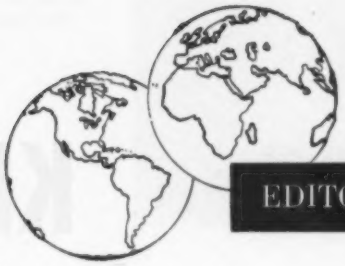


EDITORIAL

REFINING BECOMES A GLOBAL INDUSTRY

WHILE THE generally accepted estimates of the world's production of crude oil during the current year forecast a probable increase over 1951 of seven to eight percent, bringing daily output close to 13 million barrels, the rise in refining capacity is progressing even more rapidly, adding a million and a half barrels since the beginning of last year or upwards of 15 percent.

Since 1939, world production and consumption have doubled, and since 1948, when post-war activity began to come fully into effect, they have expanded by 33 percent. During the latter period, refinery construction and expansion have added yearly four million barrels or roundly 40 percent to daily throughput capacity. Thus the refining industry has kept itself in advance of requirements throughout the period of rapid expansion that began with World War II, preserving its long record of never failing to meet every demand made upon it. In order to do this, it has more than doubled its capital investment, and its yearly expenditures.

No less significant than the sustained growth of refining capacity has been the expanding rate at which processing plants have become distributed around the world, making refinery operation a truly global enterprise, bringing the producing, refining and marketing phases of the oil industry into closer connection and putting more and more emphasis upon its international character.

As late as 1946 the United States was producing roughly two-thirds of the world's supply of oil, and refining between 60 and 65 percent of the whole quantity. Refining capacity in some parts of the Eastern Hemisphere actually was lower than it had been a half dozen years earlier, owing to the damage, amounting in come cases to complete destruction, inflicted by wartime bombing. At the same time various factors, including the scarcity of coal and the necessity of prompt industrial restoration, combined to create a rapidly growing demand for fuel oil and other petroleum products.

In a report issued in 1947 by the National Petroleum Council of the United States, attention was called to world wide deficiencies in material supplies and to their effect upon all branches of industry. In this connection the Council, which of course could offer suggestions only to companies located in the United States, said: "This situation will not be brought into balance until American petroleum companies operating in foreign areas are able to rehabilitate existing plants which were damaged during the war and to construct necessary expansion. The satisfaction of these foreign needs will relieve the load on our own domestic industry which at present is heavily overburdened."

In the following year, the United States adopted the policy of extending financial assistance to other countries to better their economic position. The Economic Cooperation Administration recognized that one of the most effective means of improving conditions was to add to their petroleum refining equipment, thereby lessening the drain upon their declining dollar resources. Through ECA, its European counterpart OEEC, state cooperation and the voluntary action of American companies with overseas interests in constructing processing plants abroad, a strong impetus was given.

Between 1948 and 1952, partly through the encouragement provided by ECA (though only a minor part of the needed funds were supplied from that source), the refining capacity of the United Kingdom and continental European countries outside the Soviet orbit was raised from 640,000 to 1,580,000 barrels per day. In the Middle East, despite the loss of 450,000 barrels per day of petroleum products following the seizure of the world's largest refinery at Abadan by the Iranian government, there was a small rise in capacity. In the Far East and Oceania, petroleum processing facilities were enlarged by 190,000 b/d or more than 100 percent. In the Western Hemisphere, aside from the United States, daily refinery capacity has risen by more than a million barrels.

As a result of the steadily expanding development of the international trend in refining operations, the United States now possesses 54 percent of the world's greatly enlarged refining capacity and other countries 46 percent, the proportions being not widely different from the division existing in the production branch of the industry. The change is one that makes for better balance and greater stability in what is by necessity fundamentally an international industry.

KENT REFINERY

WILL ADD 4,000,000

Sketch of the 600-acre refinery site being developed by Anglo-Iranian Oil Co. on the Isle of Grain.

Lifting a 12-ton heat exchanger into position.

BY E. LAWSON LOMAX

THE KENT REFINERY now in construction for the Anglo-Iranian Oil Company under the engineering direction of E. B. Badger & Sons (Great Britain) Ltd., a division of Stone & Webster Engineering Corp., will go far toward freeing the United Kingdom from dependence on imports of petroleum products. The first stage in the development of the plant is now approaching completion and is to be followed by further expansion which will raise its throughput to 40 million tons per year, upwards of 80,000 barrels daily, and double the capacity originally planned.

The site of the refinery is on the historic Isle of Grain, which in the early

Manifolds for two of the refinery crude tanks.

TONS TO BRITAIN'S PROCESSING CAPACITY

days of its history, circa 250 B.C., was an authentic island bounded by navigable waters of the Thames, Medway and Yantlett Creek. Today, although it still retains its name, it can no longer be classed as an island.

Pottery of this early period, made by the people of Kent, has been found at Wallend; when the Romans came they made pottery too; later came the invasion of the Jutes and Saxons, when Kent alone maintained its name among the divisions of southeast Britain. About 500 B.C. the marshes of the island became sheep grazing lands, for which purpose they have been used to the present day.

Early industry was the recovery of seasalt from saltpans, filled at high tide and left to evaporate. From A.D. 600, Kent was Christianized under the influence of Saint Augustine and King Aethelbert, and the first wooden church was built on the island.

About 1,000 years ago, the sea invaded the island and the abbey and monasteries located there were compelled to build earthen walls against the invasion; at the present time the same situation exists, with walls heightened and widened over the centuries. It is estimated that the Isle of Grain is sinking below sea level at the rate of a foot a century.

In 1866 a fort and garrison was established on the island and in 1882 it was connected to the mainland by railway to feed the Port Victoria branch of the Southeastern and Chatham Railway and the continental service to Flushing from that port, since abandoned.

The Isle of Grain's first introduction to the petroleum industry was in 1923 in the shape of the Medway Oil and Storage Co. which built an oil refinery and storage tank farm on the southwestern corner of the island. The refinery was shut down and dismantled in 1932, but the storage has remained and expanded. In 1939, on ground acquired on Wallend Farm, a modern underground petroleum storage installation was built and in 1944 a branch of "Pluto" was connected to this storage, gasoline being pumped to the southwest coast of Kent and so across the Channel to France to feed the armies of the Allies.

It can well be understood that many construction problems were involved in the erection of a refinery on such a site. The total area of the land acquired on the island by Anglo-Iranian is about 2,000 acres, the area developed for building purposes at the present time being about 600 acres.

The alluvial mud of the marshes covered the whole of this area, interposed with innumerable shallow fleets or ditches, the depth of water varying with the rise and fall of the tide. This alluvial mud has little or no bearing value for surface structures; the sub-surface consists of patchy beds of gravel, varying considerably in area and depth, and very irregular in location, while below this, in variable depths, London clay is encountered. These variations in depth have considerably influenced the general layout of the refinery, and also have entailed a large amount of surface preparation before foundation work prior to erection work could be commenced.

Consolidation of ground has been accomplished partly by removal of gravel soil from the higher sections to the lower ones, and partly by consolidation by means of sand dredged from a sand bank in the Thames Estuary, which was then pumped ashore as a slurry and allowed to drain. For this purpose, 3,000,000-4,000,000 cubic yards of earth had to be moved and 1,000,000 cubic yards of sand pumped from the estuary.

As ground conditions differed substantially, various methods of foundation structure had to be employed; piling was used where concentrated loads had to be carried; concrete rafts were used where conditions were favorable for these, and in some areas deep excavation was employed, preparatory to laying down foundations.

Work on the site was commenced in mid-1950, the scheduled size of the refinery being then 2,000,000 tons per year, but this has now been increased to 4,000,000 tons and the first part of the building program will be completed and the plant in operation in mid-1952.

The erection program is being carried through in three stages:

Stage I: The crude oil distillation plant, together with the necessary auxiliary plants for sweetening and blending chief products. This stage is nearing completion.

Stage II: This stage is due for completion in mid-1953, and embraces the catalytic cracking plant with its auxiliary vacuum distillation, fractionation and stabilizing units, together with treating and sweetening units for the manufacture of premium grade motor fuels.

Stage III: Comprises the lube oil refinery, with its vacuum distillation unit, de-asphalting, solvent refining, de-waxing, clay treatment and blending and packaging units, and is scheduled for completion at the end of 1953.

The complete refinery, while flexible enough for the processing of many crudes, is primarily designed for treating Middle East crudes in which the Anglo-Iranian Oil Co. has had many years of experience, and the principal products on a yearly basis will be, in tons:

Motor spirit	950,000
Premium grade kerosine	110,000
Tractor vaporizing oil	29,000
Gas oil	490,000
Lubricants	140,000
Fuel oils	1,862,000

For the discharge of crude oil and for loading of refined products, four deep water jetties, with pipe line connections serving all tank farms, have been built by McAlpine and Partners. These are concrete steel reinforced structures and stand on steel box piles; they extend out so far into the river that there will be about 40 feet of water at low tide, thus enabling the largest sized tankers in operation or projected to discharge at all stages of the tide.

From these jetties the crude will be pumped into crude storage tanks, the projected number and size of these being sufficient to insure six weeks supply to the refinery. Steel scarcity has caused some delay in completion of the full storage capacity.

The nominal capacity of the crude oil distillation unit is 80,000 barrels per day and it is the largest of its kind in Europe. It was designed by E. B. Badger and Sons (Gt. Britain) Ltd., and was originally intended for Haifa. It was partly constructed for that purpose in the United States, but when trouble arose between Israel and Arab countries, it was temporarily put into storage and fabrication was later completed for its use in this refinery. The erection was carried out by Wimpeys.

It consists of a pre-flash column and a main column with the usual accessories of pipe still, heat exchangers, pumps and control instruments. The flash column is bottle-shaped and is 90 ft. high; the bottom and wider section is 18 ft. 6 in. in diameter and contains 11 trays, the upper and narrow section being 10 ft. 6 in. in diameter and containing 10 trays.

The overheads pass on to the stabilizer unit, while the bottoms go to the main distillation column which is 22 ft. in diameter and 144 ft. 6 in. high, with 29 trays. The fractions taken from this unit are:

Overhead from flash column, light spirit to stabilizer.

Overhead from main column, benzene to sweetening.

Side sections main column, kerosine to treatment.

Side sections main column, light gas oil to stock.

Side sections main column, heavy gas oil to stock.

Residue main column, fuel oil to storage or feed stock to the vacuum distillation units.

The stabilizer unit consists of a depropanizing and debutanizing column. It has a nominal capacity of 12,000 barrels per day, and is built to the company's designs by Ashmore, Benson & Pease. The depropanizing column is 4 ft. 6 in. in diameter by 106 ft. 3 in. high and contains 36 trays, its working pressure being 300 psig. The overheads go to works fuel and the bottoms to the debutanizing column. It is designed as two sections in one unit, a stripping section and a rectifying section. The stripping section is 9 ft. in diameter with 10 trays, and the rectifying section is 6 ft. 6 in. with 14 trays, the total height being 82 ft. 6 in. and its working pressure 115 psig.

The overhead product is butane which passes on for treatment and then to storage for sale as such or for fuel as desired. The bottoms go to the treating plant and then to the sweetening plant for blending with overheads from the main distillation column as regular grade motor spirit. Part of the kerosine side stream from the main column goes to the Edeleanu sulfur-dioxide plant for finishing. Light and heavy gas oils go direct to storage.

Spirit treating plants consist of solutizer treating and copper chloride sweetening units and are built to the designs of the Anglo-Iranian Oil Co., the solutizer plant being engineered by Costain-John Brown and the copper chloride unit by Foster Wheeler.

Two copper chloride sweetening units are of 8,000 barrels per stream day each, in which the overheads and residues from the stabilizer unit, together with the overheads from the main distillation column, will be treated for finished products.

The solutizer unit is of 6,000 barrels per day nominal capacity and is used for treatment of overheads from the stabilization unit, together with the catalytic cracked spirit when that plant is in operation.

The kerosine fraction is finished for sale as premium kerosine by the Edeleanu process, the unit having been designed by Badger with a nominal capacity of 1,000 tons per day at 100 percent treatment by volume with sulfur dioxide, the extract being used for tractor fuel. No acid treatment is used.

The above units, together with the general refinery auxiliary units, comprise Stage I of the refinery construction and will be in operation while the further stages, which are well advanced, are being completed.

As mentioned before, Stage II comprises the catalytic cracking plant with its auxiliary units, the first of which is the vacuum distillation unit for the production of catalytic cracker feed stock.

There are two identical vacuum distillation plants, either of which may be used for the production of catalytic cracker feed stock or for the preparation of lubricating oil distillates. The capacity of each unit is 17,500 barrels per stream day.

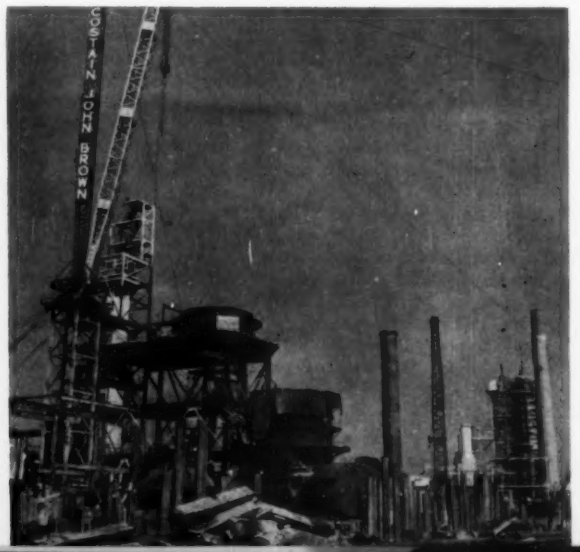
The fractionating columns are in the form of an inverted bottle; the bottom section, which is fitted with non-continuous decks, being 22 feet in diameter and the top sections fitted with 26 trays 26 feet in diameter, the total height being 119 feet.

Five side streams, including gas oil, can be taken off, besides asphalt bottoms which go to works fuel. At present there is no plan for the production and sale of asphalt as such. When the unit is being used for the production of catalytic cracker stock all the distillates are bulked, but when used for the preparation of lubricating oil stocks the fractions are collected and treated separately. One of the vacuum towers was built by Daniel Adamson and the other by Motherwell Bridge & Engineering Co.

The fluid catalytic plant, built to the designs of M. W. Kellogg Co., will make use of an aluminum-silica microspheroidal catalyst. It has a rated capacity of 12,500 barrels per stream day. Erection of

Overhead piping in cat cracker plot with distillation unit in background.

Sections of regenerator ready for lifting into position for the cat cracker.



the plant is being carried out by Costain-John Brown. The reactor and regenerator has been fabricated by Motherwell Bridge & Engineering Co.

Operation is by the conventional method under which the preheated feed stock is injected along with the already heated catalyst from the regenerator into the bottom of the reactor. Here the catalyst settles to form a dense fluid bed and brings the feed stock up to the required cracking temperature.

Cracking takes place with the formation of coke on the catalyst. The cracked oil vapors pass through cyclone separators for the separation of entrained catalyst and then to the fractionating column, the separated catalyst being returned to the bed. The depth of the catalyst bed is maintained automatically and the spent catalyst from the top passes down to the bottom through an annular space provided for the purpose and is then elevated by combustion air to the regenerator where coke is burned off and the regenerated catalyst returns to the reactor, thus completing the cycle.

The cracked vapors pass to the fractionating column, which is 12 ft. in diameter by 92 ft. 5 in., with 21 bubble trays, all fabricated by G. A. Harvey, and from there go to the debutanizing towers, the absorber stripper and the rerun tower, for final separation of the cracked products into propane, butane, light gasoline, heavy gasoline and residues of recycle stock.

The following are the main dimensions of the various towers:

Depropanizing: 3 ft. 6 in. diam. by 72 ft. 6 in. high, fitted with 30 trays and working at 270 psig; bottom temperature 217°F; made by Marshall Anderson, Glasgow.

Debutanizing: 6 ft. diam. by 79 ft. 6 in. high, fitted with 30 trays and working at 180 psig; bottom temperature 430°F.

Absorber stripper tower: 3 feet and 5 ft. 6 in. diam. by 105 ft. high, fitted with 45 trays, working at 185 psig; bottom temperature 205°F. The two towers are supplied by John Thompson, Wolverhampton.

Rerun tower: 7 feet diam. by 60 ft. 6 in. high, fitted with 24 trays, working at five psig; bottom temperature 480°F., made by Motherwell Bridge & Engineering Co. Cooper-Bessemer compressors made by Harland & Wolff are used, there being 2 x 660 hp units and 2 x 440 hp units, all two-stage, working at 220 psig. The blowers were made by B. T. H. and Metro-Vic and are steam turbine driven.

The cracked spirits are solutizer treated and copper chloride sweetened and are blended with straight run spirits for the manufacture of premium grade motor fuels. Completion of this plant will mark Stage II of the erection program, leaving the lubricating oil plant for Stage III.

The vacuum distillation plant which is the primary process in this section has been described above. The process for lubricating oil manufacture consists of de-asphalting, solvent refining, de-waxing, clay treatment and blending. The plant is designed to produce 140,000 tons of finished lubricants of various grades per year.

The first part of the process is the de-asphalting unit of Kellogg design with a rated capacity of 4,500 barrels per day. Solvent treatment is by furfural, using the Texaco process, the plant for which is engineered by The Lummus Co., and is designed for a capacity of 5,800 barrels per stream day.

The extraction or solvent treating tower is 11 ft. 9 in. diam. by 106 ft. high, and is fitted with eight trays. Next in order are the towers for recovery of solvent from the raffinate and extract, the furfural redistillation tower, the water removal tower, and the de-aerating tower.

The raffinate stripping tower is in two sections with a total height of 63 ft., the flash section is 5 ft. 6 in. diam. by 22 ft. 6 in. in height, with six trays, and the stripping section 5 ft. 6 in. diam. by 41 ft. 6 in. in height with 19 trays. In this tower the raffinate or lube oil stock is stripped of the furfural dissolved in it before going on to the wax extraction plant. The extract, which contains a much larger percentage of furfural than the raffinate, then passes to the extract flash tower where a large proportion of the furfural is removed.

This tower is 7 ft. 6 in. diam. by 28 ft. high and is fitted with four trays. For final removal of furfural, the extract passes on to the extract stripping tower where the final traces of furfural are removed. This tower is in two sections, the flash section and the stripping section. The former is 5 ft. 6 in. diam. by 22 ft. high and fitted with six trays, and the latter 3 ft. 6 in. diam. by 41 ft. 6 in. high, fitted with 19 trays.

The recovered furfural then requires redistillation, and water and air removal. The redistillation tower is also in two sections, the bottom section being 7 ft. 6 in. diam. by 35 ft. 6 in. high, fitted with six trays, and the upper section is 5 ft. 6 in. diam. by 35 ft. 6 in. high, a total height of 71 ft. The water removal tower is 3 ft. diam. by 32 ft. 6 in. high and is fitted with 16 trays.

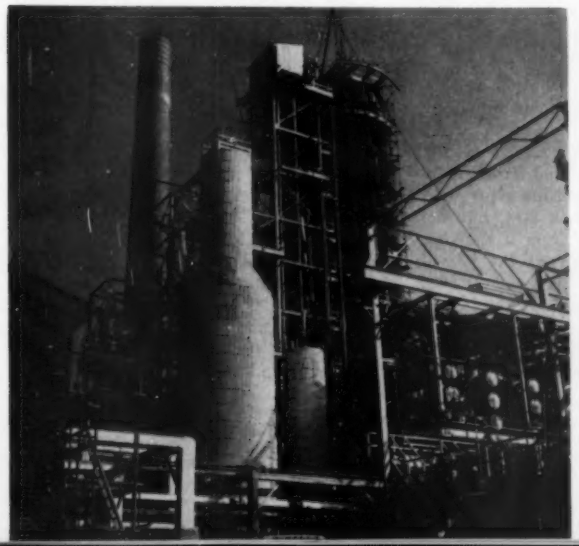
The redistilled, dried and de-aerated furfural passes back to storage for further use in process.

With the exception of the extract flush tower, which was fabricated by John Thompson, all the above towers were fabricated by Daniel Adamson to the designs of The Lummus Co.

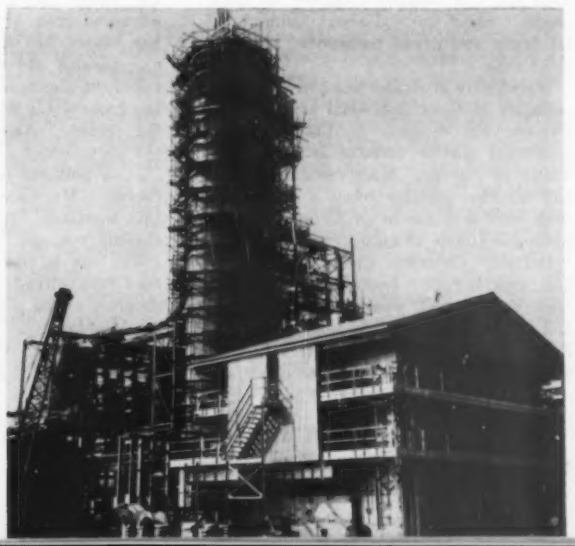
The methyl-ethyl ketone wax extraction plant, which has a capacity of 3,290-4,500 barrels per day, according to the type of raffinate being treated, is built on conventional lines for this type of plant. Various firms have fabricated equipment. In general, the towers and vessels are by Motherwell Engineering Co. The wax free

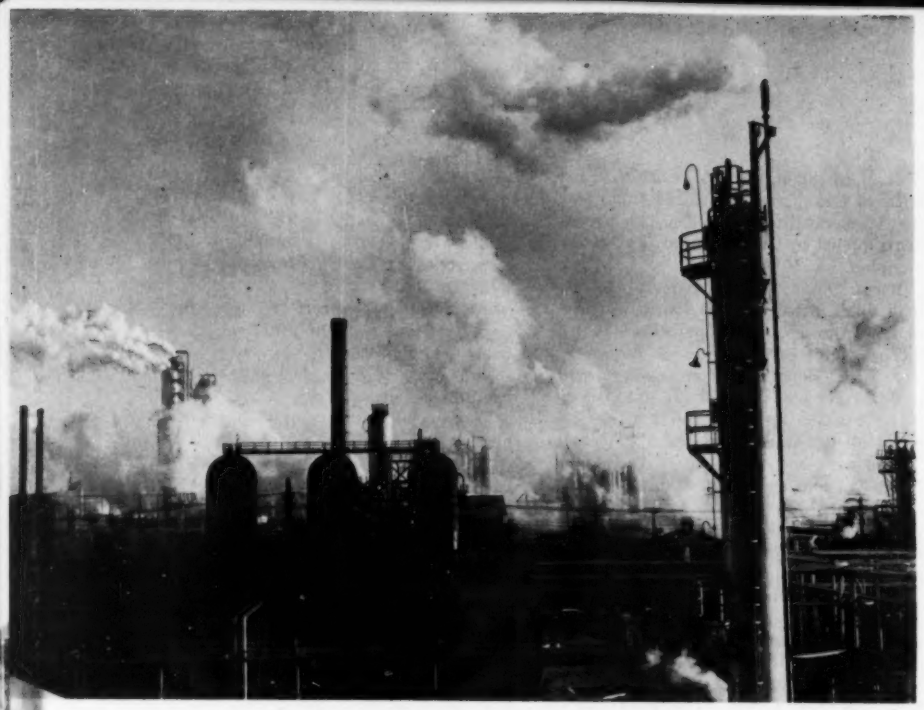
(Please turn to page 136)

Topping unit showing completely insulated primary column and stripper in foreground.



Topping unit furnace showing secondary column in background during construction.





Scenes such as the above in an urban oil refinery are causing authorities to allege that refiners are contributing to mounting air pollution in American cities.

AIR

A PUBLIC RELATIONS

HAVING SOLVED effluent water pollution problems as a result of sustained cooperative study, the oil refiner now is confronted with another problem—air pollution.

The problem is not confined to the Los Angeles region, which has become celebrated for its eye-irritating smog. It is present in a number of other communities where industrial operations have been concentrated. Apparently, every refinery with an installation in or near an urban community soon must recognize the problem and do something about it. It is one of the many difficulties resulting from industrial progress.

Los Angeles Basin refiners were the first to be involved because of the peculiar inversion there of normal air layers which retards diffusion, and low wind velocities and mountain barriers which prevent sweeping the smog away. Rumor has it that the Indians first recognized the peculiarity of meteorological conditions in the Los Angeles Basin by calling it the "valley of many smokes." Certainly as early as 1909 the Los Angeles Chamber of Commerce became worried about losing tourist trade and urged passage of a smoke ordinance.

World-wide attention was focused on air pollution in other industrial areas by the Donora, Pa., tragedy in 1948, and the somewhat similar disaster in the Meuse Valley in Europe. More recently Mexico had its own disaster when a number of lives were lost due to an accumulation of hydrogen sulfide in an oil area.

Detroit, Chicago, Cleveland, Cincinnati, Baltimore, St. Louis, Pittsburgh and New York are all aware of air pollution and are attempting to find out who is to blame and what to do to minimize or eliminate it. Most of these cities are blessed with good wind velocities to air-condition the communities. It is said that the New York-New Jersey area soon would become uninhabitable if meteorological conditions there were similar to those in Los Angeles.

City and county legislation has been adopted in certain areas and authorities have been selected to regulate air pollution. Some of the authorities are adopting a reasonable attitude toward industry and are trying by education and assistance to improve the situation. Others are wielding a big stick. In New York City within the past year both attitudes were displayed. One city official working on smoke control favored cracking down on such companies as Consolidated Edison with daily fines, and another recognized that "Con Ed" was spending several millions at its plants and favored giving the company time.

At the recent API refinery division meeting at San Francisco a paper entitled "The Policeman is Coming" was read by Vance M. Jenkins of Union Oil Co. He recited the theories which have been advanced from time to time as to what has caused Los Angeles smog conditions and pointed out that "when the cop is called in about an air pollution matter, the proceedings which ensue do not follow the ordinary American system . . . for the party which summons him is usually . . . a political agency that governs by decree." Mr. Vance closed his paper with this warning: "Don't look now, but the shadow you see is not from a smoking stack. It is the shadow of the policeman who already has his hand on the shoulder of the petroleum industry in Los Angeles County."

When air in an urban community is contaminated, the policeman unfortunately is likely to place his hand on the oil refiner's shoulder first. This is because of the pervasive odor of certain mercaptans emanating from a refinery and not always because of smoke or noxious gases which may contribute to smog. Los Angeles is a prime example of misconception on the part of the public and of control authorities. Early theory was that oil refineries were responsible for smog because some sulfur dioxide was liberated. Refiners banded together and installed sulfur recovery equipment, but the smog got worse. All told, the oil industry in the Los Angeles area has spent about $12.5 million for air pollution control equipment. Now it has been necessary to develop new theories regarding smog causes.

In Cleveland the Standard Oil Co. of Ohio was accused by some of sulfur air pollution although it was operating on sweet crude whereas a nearby chemical plant was a very large processor of sulfur. Also it was complained that air contamination was greater on Saturdays and Sundays when the facts were that a steel mill shut down its sulfur recovery plant on week ends. Complaints to Sohio were heavy during a period when the refinery was shut down.

The oil refiner in an urban community is sensitive to the attitude of the public because of the effect on gallonage which may result if customers think that the plant is responsible for smog. A steel mill usually is less concerned because few customers buy steel products by mill brand name. The same usually is true of a chemical plant. Nevertheless, the managements of concerns of this type are becoming aware of difficulties which may come in the future unless pollution problems are solved.

Henry B. du Pont, vice president of E. I. du Pont de Nemours and Co., told the recent air pollution symposium at Los Angeles that the management of his company requires that all pollution prob-

POLLUTION

PROBLEM FOR ALL URBAN OIL REFINERS

Cartoons from the Esso Standard booklet explaining that refinery flares serve as safety valves.

lems be solved before a new plant is erected. This involves studies of meteorological conditions and fish life in streams. The company has an investment of $25 million in pollution prevention equipment at its various plants.

A recent survey by *Fortune* magazine in Terre Haute, Ind., revealed that more people want industry to eliminate dust, smoke, noise and odors than ask for pay above average wages or playground facilities for children.

As noted previously, the public may entertain an erroneous idea as to smog causes. Esso Standard Oil Co. has become aware of this recently, partly because the New Jersey turnpike adjacent to the huge Linden refinery now brings thousands of motorists near a number of refinery flares. Esso has prepared a booklet which is sent to those who ask or complain about the flares. The book is entitled "Refinery Safety Flares: What and Why."

The Esso booklet states in part that "in refining, some petroleum is turned into gases which are cooled, compressed and otherwise treated to make gasoline, heating oil and other products. Sometimes it isn't possible to cool these gases quickly enough, or a compressor is taken out of operation for inspection. When this happens, the gases must be released to relieve the pressure on equipment. If they are not, a pipe may leak and the gases, which are heavier than air, flow along the ground where they come in contact with a spark or flame.

"To eliminate this possibility quickly, the gases which cannot be diverted to other equipment are piped to stacks high above the refinery where they are ignited and burned off harmlessly. When the gases reach the top of the stack, the normally small pilot light suddenly billows into a sizeable flame and, we regret, some smoke.

"We are hard at work and close to a solution, we think, in reducing both the flame and the smoke. In fact, Esso plants spend more than $500,000 each year to maintain rigid atmospheric controls. This is exclusive of investments in new equipment and methods for such improvements. Soon perhaps we may eliminate this problem. Meanwhile, we see that it occurs no more than is absolutely essential in a busy plant like ours.

"The automatic safety flare, as a matter of fact, performs much the same function as the safety valve on your furnace, or pressure cooker. When it lets go, it may startle you a bit, but it's awfully good to know it's there when needed. So whether the refinery safety flare is only on a 'stand-by' basis or performing its necessary function, it's our assurance and your assurance that everything's under control and that Esso is hard at work to serve you."

Now that sulfur dioxide has been shown not to be the important contributor to smog, other villians are being denounced. In 1950 it was found that 50,000 tons of fuel and rubbish are burned daily in the Los Angeles area with the resulting release to the air of 1,800 tons of combustion products other than CO and CO_2.

Latest theory to be expounded in Los Angeles is that olefin vapors from gasoline blow-by in motors and evaporation react with ozone to form aerosols of complex composition which stay in suspension in the air for long periods.

One of the largest sources of combustion products in the modern urban area is the automobile. Usually the exhaust gases are thought of as containing carbon monoxide, carbon dioxide, oxygen, hydrogen and small amounts of hydrocarbons.

Recent studies suggest that the volume of hydrocarbons released to the air through piston blow-by is of considerable importance in smog formation. J. Q. Payne and H. W. Sigworth of California Research Corp. conducted a series of dynamometer tests which revealed that noxious products which contribute to eye and throat irritation are more prevalent in blow-by than in exhaust. Blow-by is affected greatly by mechanical condition of the motor. The concentration of noxious products is affected by type of fuel, carburetor adjustment and power output. The investigators found paraffins, olefins, aromatics, cyclics, acids, alcohols, aldehydes and an organic hydroperoxide in blow-by gases.

In Los Angeles County there are two million cars which consume 12,000 tons of gasoline daily. Hydrocarbon loss to the atmosphere from these cars has been calculated at 850 tons per day. In the heavy traffic periods from six a.m. to six p.m. the losses are at the rate of 1,275 tons per day. It has been found that the average car loses five percent of its fuel by blow-by and out the tailpipe in steady driving and as much as 19 percent during periods of deceleration. Stop and go driving in the cities thus increases pollution of the air by such gases as methane, acetylene, paraffins, and olefins in the C_2 to C_7 range.

Los Angeles Air Pollution Control District is determining hydrocarbons in the air by complicated methods. Concentrations up to one ppm have been found.

Domestic consumption of natural gas also contributes to the modern smog problem in urban areas where coal is not burned largely. E. L. Hall of the American Gas Association laboratories has found that domestic gas appliances may produce 15 to 500 ppm of oxides of nitrogen and 0 to 11 ppm of aldehydes. On the basis of these findings, Los Angeles air may be contaminated with 19.25 tons of NO_2 and 1.25 tons of aldehydes per day through the consumption of 318,000,-

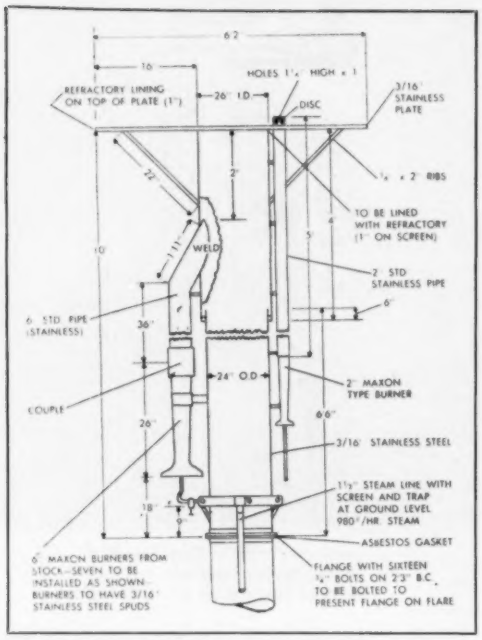


Fig. 1. Flare tip designed by Standard Oil Co. of Ohio to give good combustion over a wide range of gas supply.

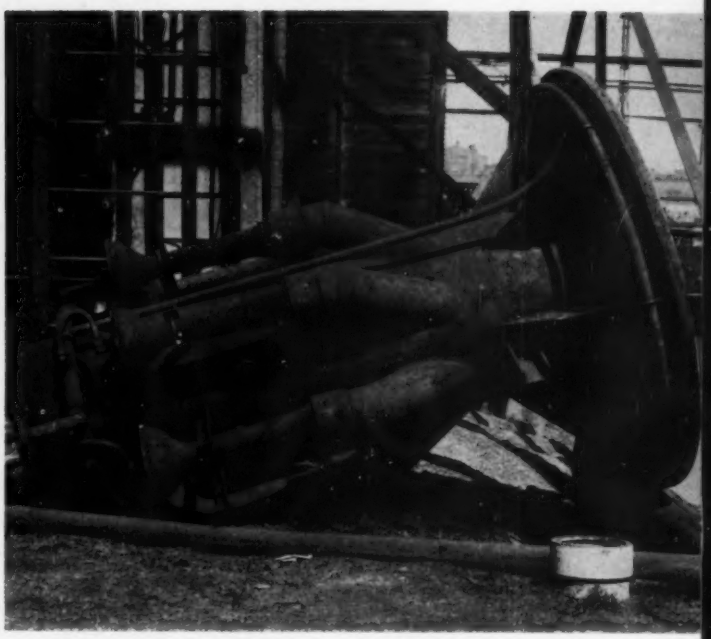


Fig. 2. Improved flare tip ready for installation at Sohio's Cleveland plant. Photo by G. W. Hanneken.

000 cubic feet or 7,600 tons of natural gas.

Incomplete combustion is, of course, the cause of the release of this type of pollutant. To show how serious this may be, Mr. Hall presented the following tabulation to the recent smog conference at Los Angeles:

PRODUCTS OF INCOMPLETE COMBUSTION
(Parts per million)

	Natural Gas	Coke Oven Gas	Butane
Percent Aeriation	2.72	67.5	49.5	49.0
Formaldehyde	0.22	133.0	30.2	842.0
Acetaldehyde	0.30	0.8	2.0	52.0
Formic Acid	2.20	28.2	9.7	208.0
Total	2.72	162.0	41.9	1,102.0

In cities where coal is largely used for domestic heating, the average home is a substantial contributor to air pollution. This has been shown by air analyses which reveal heavy seasonal changes in pollution. In cities such as Cincinnati where natural gas is supplanting coal, there has been a great drop in winter pollution.

Air pollutants consist of both gases and particulate matter. Of the gases, sulfur dioxide, hydrogen sulfide and hydrogen fluoride are generally considered to be of industrial origin, but have been shown to be of domestic origin as well. Other pollutants such as oxides of nitrogen and ozone are natural constituents of the atmosphere which contribute to smog formation.

Of the solid particles in the air, the larger ones settle readily, but the fine particles usually called aerosols settle so slowly that their suspensions are mechanically stable. The upper limit of aerosol size is about 100 microns.

Sulfur dioxide arises from the combustion of nearly all fuels. Hydrogen sulfide, mercaptans and other organic sulfides cause odor nuisances in concentrations much below the smallest concentration of SO_2 detectable by odor.

In the Los Angeles area eye-irritating smog which causes injury to vegetation has been attributed in part to intermediate oxidation and polymerization compounds caused by the action of ozone and nitrogen oxides on olefins of about five to nine carbon atoms with or without the action of sunlight. The ozonides and peroxidic compounds have not been analyzed directly because of their instability. Analysis has been by such methods as infra red or mass spectrography.

Generally recognized effects of air pollution are of three basic types: nuisance, economic and health. Dirt, offensive odors, loss of visibility and eye irritation are of the nuisance type which may create much of the public outcry against industry. More important economic effects include discoloration of paint, corrosion, soiling of clothing, household furnishings, and store merchandise, injury to vegetation and livestock. Health effects have been highlighted in recent years by the Donora tragedy and more recently by the loss of life in Mexico due to hydrogen sulfide.

Not much is known about general health effects of air pollution. Such studies of effects on persons in good health, on pre-existing diseases and on resistance to common diseases will require extensive and painstaking investigation by public authorities and research organizations. Technical difficulties in the way are many and complex.

In general, to conduct a study of air pollution, it is necessary first to perfect methods of accurate measurement of pollutants and determine sources. Source studies must include minor human activities such as trash burning as well as large industrial enterprises.

Interpretation of analytical results is of major importance after sources have been discovered, samples taken and analyses conducted.

Standard Oil Co. of Ohio began working on the air pollution problem some six years or more ago. Its program of study and prevention has been praised by Cleveland newspapers and by H. G. Dyktor, director of industrial hygiene for the city. Mr. Dyktor is an official of the cooperative school of thought who believes that progress will be made much faster by education and persuasion than by strong arm methods. He has had to take a good deal of abuse himself from irate citizens, but appears able to "take it" and continue his program of working with industry.

Cleveland is trying to find out what are the major sources of pollution and what the contaminants consist of. An-

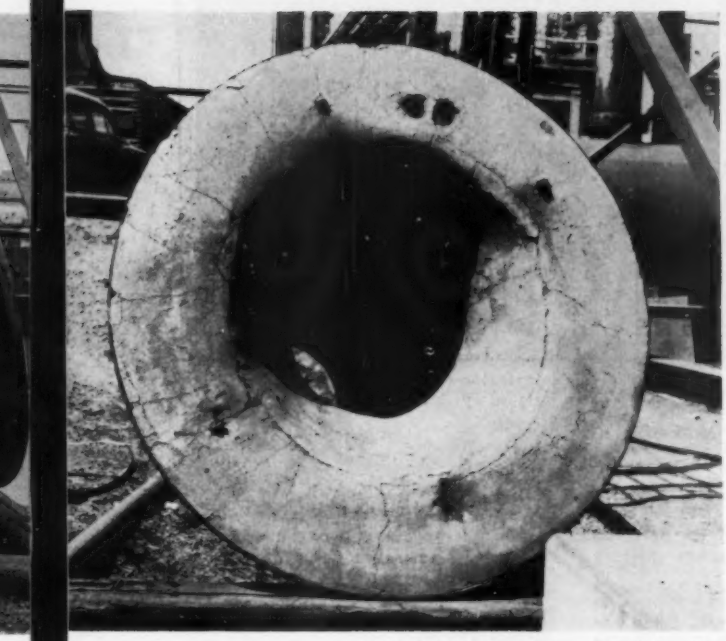


Fig. 3. Refractory in improved design flare tip after three months service. Photo by G. W. Hanneken for Standard of Ohio.

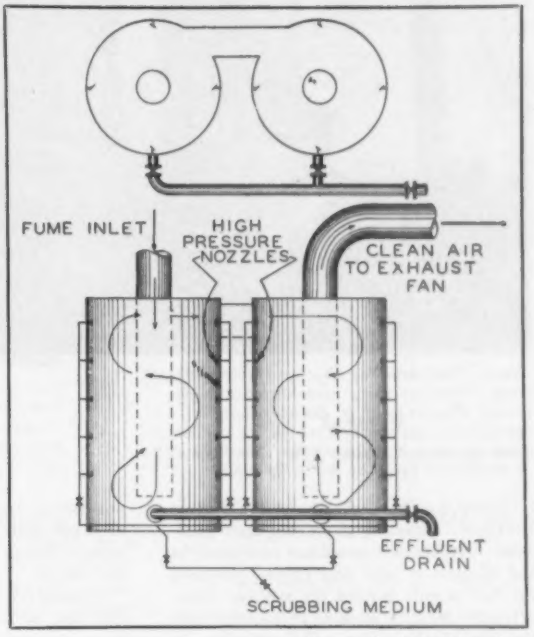


Fig. 4. Design of fog filter used by Sohio for scrubbing acid fumes.

swers require comprehensive knowledge of wind direction and velocity, temperature, pressure and relative humidity. Here, as in many communities, it has been noted that localized meteorological conditions have a great deal to do with air pollution. Sohio, in cooperation with other industries and the United States Weather Bureau, has set up weather stations to aid in the study of pollution in the highly industrialized Cuyahoga Valley.

Sohio's weather stations are equipped with an anemograph, a hygrothermograph and a recording aneroid barometer. Wind direction and velocity are recorded on a single 14-day chart. Air temperature and relative humidity are also recorded on a single 7-day chart, and the barometic record is recorded on another 7-day chart. Additional instruments are to be installed later. Already the equipment has shown remarkable local deviations. Wind direction may vary from five to 15 degrees at the Sohio No. 1 refinery from that at the Cleveland airport eight miles distant. Velocities may be only 50 to 80 percent of airport velocities. Air temperatures vary from one to three degrees and humidity similarly. To supplement the weather data, Sohio gathers air samples at stated points for anaiysis and report to city authorities.

Although Sohio operates on sweet crude, the company has recognized the odor nuisance created by very small concentrations of mercaptans and other organic sulfides, fatty acids used in grease manufacture and hydrocarbon aerosols contained in fumes from the asphalt plant. It has attacked these problems vigorously in addition to the usual methods taken to reduce smoke from boiler house and other stacks.

At the boiler house Sohio installed an automatic fuel control system to halt smoke from normal operations. Results are checked by a densometer.

A great deal of study has gone into the flare problem in an effort to reduce the quantity of flare gas and to provide proper burning devices for the surges which are unavoidable. A primary method of reducing volume is to provide greater compressor capacity for the vapor recovery plant with stand-by equipment to take over during necessary maintenance activities. Tied with this is Sohio's program of seeking to reduce surges through better control of processing operations. Despite optimum control methods, the refiner with a reformer and a modern cat cracker may be confronted with nearly instantaneous surges of from 50,000 to 500,000 cubic feet of gas per hour. Such surges cannot be taken care of with excess compressor capacity or with gas holders. The flare must be relied on for disposal.

Sohio's first flare built in 1944 consisted of a straight vertical unobstructed section of 24-inch O.D., steel pipe, 220 feet high, the top five feet of which was clad with an additional $\frac{3}{8}$-inch thick steel plate. The flare was also provided with a pilot light consisting of a gas line having an open end and an ignition system. The bottom of the flare stack was sealed against flashback by an 18-inch water seal inside a flashback seal drum.

During the operation of this stack, several undesirable features were encountered. The most obvious and objectionable was that poor combustion conditions existed at the tip. With the quantities of gas being released, the flare burned with a very black smoky flame.

Secondly, wind currents at the top of the flare stack adversely affected operation. Also, downdrafts caused the flames to roll down the outside of the flare tip. The extremely high temperatures existing at the points of flame contact over a period of time badly warped the top of the flare and later produced long splits in the metal. Several pieces of hot metal dropped from the tip, endangering personnel in the area below.

The refinery engineers attacked the problem and developed a flare tip that has been satisfactory. The tip developed is illustrated in Figure 1. Seven air inspirators were furnished by using 6-inch Maxon burner bodies and by injecting high pressure steam into the burner jets. Air is there inspirated into the flare tip. A collar was provided at the top of the tip to keep the flame away from the body of the flare, 18-8 stainless steel being used for the tip proper.

Operation was satisfactory for a range up to 20,000 cubic feet per hour. For the most part this rate was exceeded only infrequently and was considered sat-

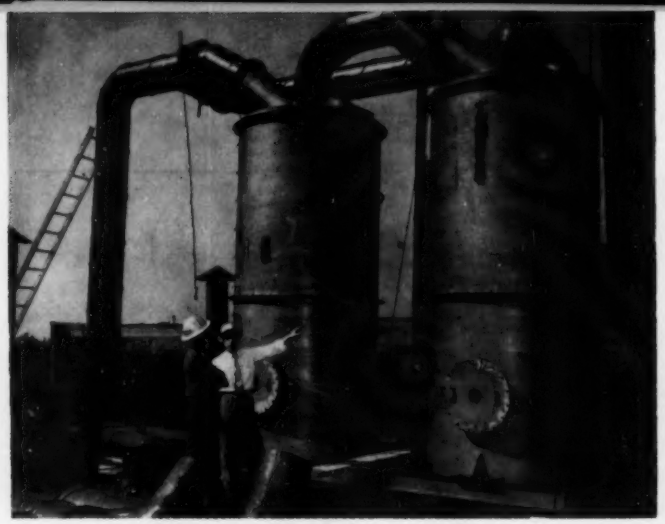


Fig. 5. Plant scale fog filter used to scrub fumes from 22 reactors and grease kettles at Sohio plant. The six by 17-ft. chambers have a rated fume capacity of 5,000 cu. ft. per min. Photo by John F. Trauger for "The Sohioan."

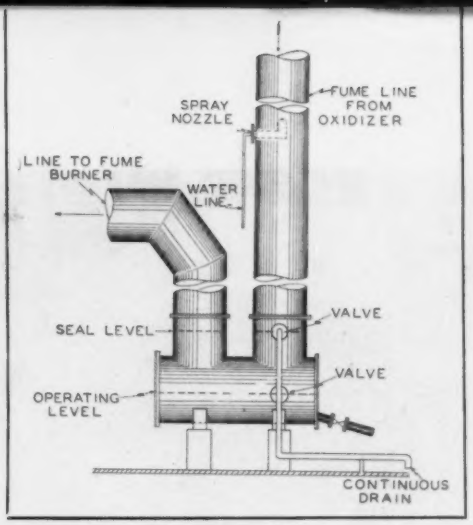


Fig. 6. Fume scrubbers for asphalt oxidizers installed by Sohio several years ago.

isfactory by the Cleveland Air Pollution Division. However, there still were problems. Combustion resonance took place in the inspirator tube and rattled windows for half a mile around the refinery. Also, after five months, spalling refractory from the top of the collar called attention to mechanical failure.

A replacement was fabricated, this time of Inconel, and the inspirator tubes were shortened to eliminate the annoying combustion resonance. This tip also used gusset plates to strengthen the joint where the collar joined the cylindrical portion of the tip. This tip remained in service 30 months. After that time, failure of the weld around the collar joint had resulted. Also the rigid connections from the inspirator to the circular steam header had cracked. Changes were made to use a transition piece between the collar and the flare to reduce the tendency toward failure at this point. Flexible stainless steel hoses were added to supply steam to the inspirator jets. This tip lasted 20 months.

Recently a replacement tip of carbon steel was fabricated due to temporary lack of Inconel. Figure 2 shows the tip after three months of service and indicates the changes in design. The main change was adding steam jets in the collar. Figure 3 shows that the refractory was in good condition due to the jets keeping the flame away from the collar. The Inconel tip replacing this one is supplied with six jets in the collar and has been in service seven months to date and shows no sign of failure. Also a flange has been provided so that the collar and gusset section can be replaced without the necessity of replacing the more costly and complicated portion of the tip. This tip can supply 1,240 pounds per hour of steam to the inspirator jets and 2,060 pounds per hour to the collar jets. Test results on this tip show smokeless operation for 25,000 cubic feet per hour of burning line gas, a short trail of light smoke at 38,000 cubic feet per hour and substantial trailing smoke at 51,000 cubic feet per hour. Success of the flare has caused Sohio to obtain patents covering the device.

Concurrent with the combustion control and meteorological work, Sohio has been attempting to take the odor out of its refining operations. These were traced down to three principal sources:

1. Acid treating of lubes which involved SO_2 and SO_3.

2. Grease manufacture involving fatty acids with unpleasant odors and certain processes evolving H_2S.

3. Asphalt manufacture evolving hydrocarbon aerosols.

F. E. Kropp, supervisor of Sohio's technical service division, and R. N. Simonsen, senior engineer, described the work done on fume abatement at the recent annual meeting of the Air Pollution and Smoke Prevention Association of America. In this paper they reported that after failing to obtain good results in removing acid treating fumes with a conventional water spray tower, Sohio tried a commercially developed fog filter.

As shown in Fig. 4, this equipment consists of two cylindrical spray chambers connected by a cross-over duct. The fumes are conducted close to the bottom of the first chamber by a central inlet tube; they then pass up the cylinder in a centrifugal motion and through the cross-over duct to the second cylindrical chamber. The gases pass down the second chamber in a centrifugal motion and, finally, up and out through a central tube in the second chamber. The gases are drawn through the equipment by means of an exhaust blower located on the outlet of the unit. The scrubbing medium was introduced through a number of fog nozzles. These fog nozzles were placed at an angle around the periphery of the cylindrical chamber so as to induce a rapid centrifugal motion of the gases. This centrifugal action served to disengage the fog droplets from the gases, and prevented entrainment of odoriferous mist. To insure the necessary high degree of atomization, the apparatus was equipped with a pump which maintained a pressure of 350 to 400 psi, gage, at the nozzles.

A three percent solution of soda ash in water was used as the scrubbing medium. At a concentration of 10,000 ppm of SO_2, at an air rate of 1,000 cu. ft. per min., the sulfur-dioxide concentration was reduced to less than one ppm.

Due to the success of the fog filter on SO_2 absorption, an experimental program was carried on to determine the feasibility of using this equipment for H_2S absorption. The first trial was made with water as a scrubbing medium. It was found that water was relatively ineffective. A second trial with a three percent soda-ash solution reduced the H_2S concentration in an air stream of 1,000 cu. ft. per min. from 2,200 ppm to 200 ppm. To achieve a higher absorptive efficiency, an eight percent caustic-soda solution was used. This solution completely removed H_2S from air even with an inlet concentration of 45,200 ppm.

By use of the fog filter, it was found that fatty acid odors can be completely absorbed, using water as a scrubbing medium. As a result of the investigations and the performance of large units in other service, a full scale installation has been made for the control of hydrogen sulfide and fatty-acid odors. Fig. 5 is a photograph of the unit which is nearly ready to go into operation. This unit will be capable of scrubbing fumes from a total of 22 reactors and kettles employed in grease manufacture. The physical dimensions and capacity of the plant-size unit are shown in Table I.

A similar sized installation is planned for the control of sulfur dioxide and sulfur trioxide vapors from the acid treating of lube oils.

In the asphalt oxidizing plant previously installed, fume burning equipment had become overloaded during peak periods. In order to decrease the load on the fume burners as well as the duct

Catalytic units developed by Eugene J. Houdry, father of catalytic cracking, to improve combustion of stack gases and decrease venting of combustible gases. Mr. Houdry, at left, is illustrating small size of individual units to Wm. W. Bowen, chief engineer of Oxy-Catalyst Mfg. Co.

TABLE I

PHYSICAL DIMENSIONS AND RATED CAPACITY OF PLANT SIZE FOG-FILTERED UNIT

Number of chambers	2
Diameter of chambers, ft.	6
Height of chambers, ft.	17½
Number of nozzles per chamber	40 (4 vertical headers (10 nozzles per header)
Diameter of concentric duct, ft.	1½
Rated fume capacity of unit, CFM	5,000
Rate of scrubbing liquid, gpm @ 400 psig	75

TABLE II

TYPICAL OPERATING CONDITIONS OF SCRUBBERS FOR ASPHALT OXIDIZERS

Fume rate, cu. ft. per min.	3,200
Fume inlet temperature, deg. F. (max.)	490
Fume outlet temperature, deg. F.	225
Water rate to scrubber, gal. per min.	10
Water inlet temperature, deg. F.	40 to 105
Water outlet temperature, deg. F.	140 to 175

collecting system, a device was designed and installed to condense the blanketing steam present in the fumes. The equipment used is illustrated in Fig. 6.

The fumes from an oxidizer are conducted down a vertical pipe, past a spray nozzle, and into a horizontal, cylindrical, drop-out section. In this section the spray and condensate are disengaged from the fumes and sent to the waste-water system. The scrubbed fumes then go to the fume burner. With the equipment described, the fume load has been reduced by 33 percent. The operating conditions are listed in Table II.

In addition to the reduction in fume loading, these scrubbers have resulted in two additional advantages. Formerly dampers and sliding blinds were used to isolate oxidizers not in use from direct connection with the fume burner. These valving devices were subject to difficulties due to asphalt accumulations on the dampers or from leaks around the blinds which added to the fume problem. By raising the water level in the drop-out section, the scrubber could be used as a water seal and thus effectively and simply isolate an oxidizer not in service. In addition, the scrubbers knock out asphaltic material which formerly accumulated and coked in the duct system causing a nasty maintenance problem. Further work on this fume problem is being directed toward improving fume combustion equipment.

Within recent months Eugene Houdry, pioneer developer of catalytic cracking, has perfected a catalytic device for improving combustion which he believes will be of value in reducing smog.

The unit is made up of two thick porcelain end plates, a spacer bar of porcelain and 73 coated porcelain rods. The end plates are joined rigidly at their centers by the spacer bar after the rods have been inserted at both ends into shallow sockets in the plates. There is some play in the rods to allow for expansion and contraction during temperature change. The rods are assembled in staggered rows and are streamlined (tear-shaped in cross-section) to insure good contact with the gases, to eliminate turbulence and offer almost a negligible resistance to the passage of fumes through the catalytic zone.

The vital part of the unit is the covering, only .003 of an inch thick, on the rods. This is a film of catalytic alumina and platinum alloy applied by a special process in such a way that it remains adherent, intact, and resists high temperatures and thermal shocks. The unit is five and a half inches long, three and one-eighth inches high and three inches wide. Oxy-Catalyst Manufacturing Co., Wayne, Pa., headed by Mr. Houdry, is manufacturing the units. A number are being installed by Sun Oil Co. on an experimental basis.

It is claimed that the device will complete combustion of stack gases, reduce air pollution and permit recovery of heat which otherwise would be lost. Such a device might be applied to asphalt fume burning such as that practiced by Sohio as well as to stack gases of boiler plants and stills.

At the recent midyear meeting of the API refinery division, a suggestion was made in a paper by Francis C. Moriarty and Max M. Fisher of Aurora Gasoline Co. that the "API Manual on Disposal of Refinery Wastes" be rewritten to improve the knowledge of the industry on air pollution control methods. They thought the section dealing with treatment of refinery waste waters to be admirable, but suggested that the sections on waste gas disposal and spent caustic treatment methods be improved.

Aurora Gasoline Company's plant is in urban Detroit. The company got in trouble with its neighbors ten years ago and a lawsuit resulted. Since then Aurora has been working diligently on the problem and has regained its lost friends. In the API paper the following steps were described:

1. To avoid H_2S pollution with consequent paint discoloration of nearby structures, Aurora connected all sour crude storage tanks with a rotary compressor which pumps vapors to a heater for burning.

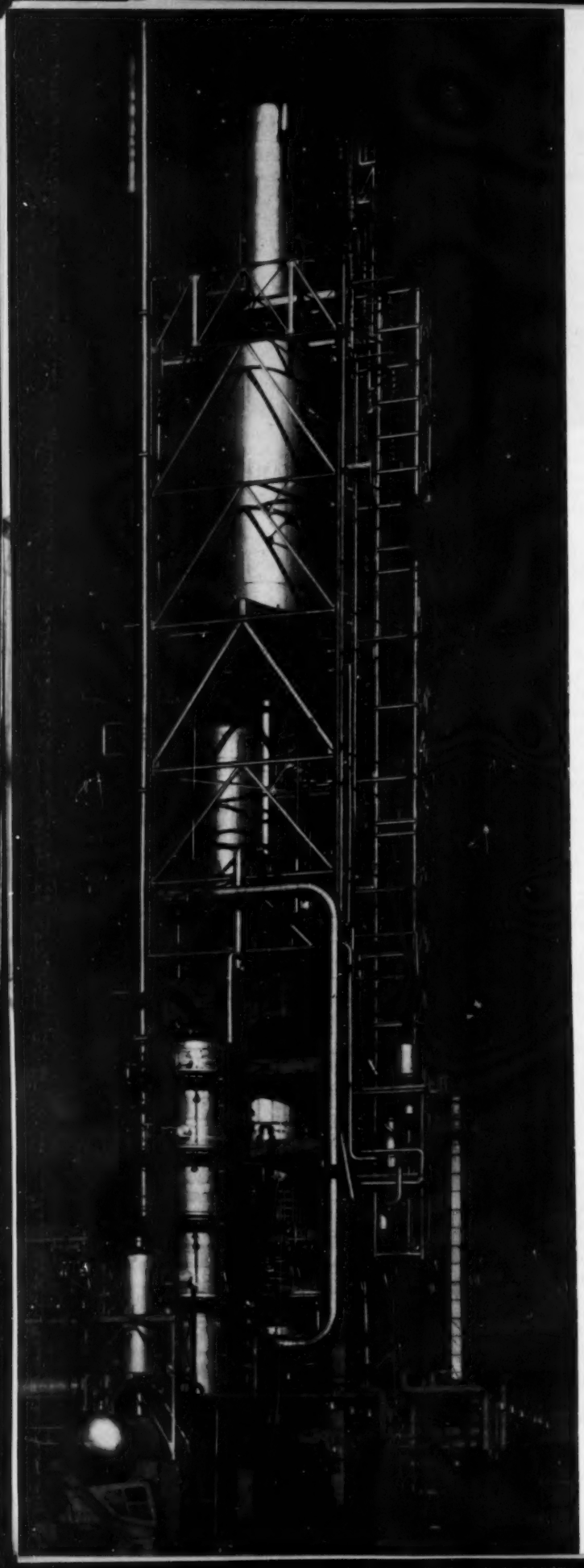
2. Fractionator and stabilizer vapors containing H_2S and mercaptans are gathered and burned as plant fuel.

3. Vapors from finished gasoline storage are recovered in a Hortondome system. This storage of sweetened motor fuel would not release malodorous gases, but would add hydrocarbon vapors to the air. The Hortondome system has reduced storage losses to provide a good payout.

4. Flue gas from the catalytic cracking unit is used to neutralize spent-caustic treating solutions. Waste waters also are stripped of volatiles with hot flue gases. Vapor effluent of both operations is fed through a steam aspirated burner to a heater before discharge to the atmosphere.

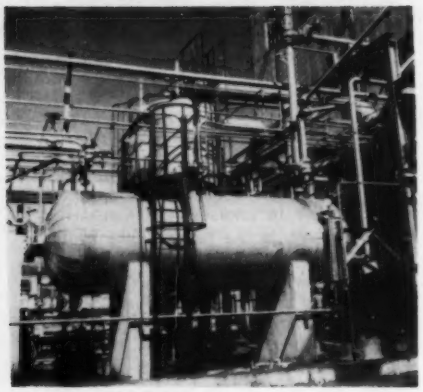
5. Process heaters give little smoke trouble, but this is not true in the case of boiler plants with changing loads or tail gas flares, which may vary a thousand fold. Aurora has installed smoke indicators on boiler house stacks. For flare gas a complicated burner system was installed which was intended to supply adequate amounts of air for any volume of gas. Results thus far have not been satisfactory and burning has been returned to a brick checker-work open flare.

In concluding their API paper, Mr. Moriarty and Mr. Fisher said that "the ever-increasing publicity being given to air pollution has indicated the need for an exhaustive appraisal of this entire subject if we, as an industry, are to move rapidly enough to avoid serious public reaction."



BY BERNARD PENE

French refinery



Dewaxing plant at Port Jerome refinery (Esso Standard).

THE LATTER HALF of 1951 and the first months of 1952 have been marked by an important change in the world position of French refining.

The rapid increase in capacity, the result of a farseeing policy and of hard work accomplished since the end of the war, has made it possible not only to cover the whole requirements of France and its African possessions[1], but also to export an important tonnage of finished products and thus cover a substantial portion of the world shortage caused by the shutdown of the Abadan refinery in 1951.

The annual crude capacity of the French refineries at the present time is more than 162 million barrels, whereas the needs of France and its overseas territories call for a supply of about 125 million barrels a year.

As an indication of trend, refined products of the French refineries in 1951 had the following distributions:

France (including French bunkers)	69.5%
North Africa and Overseas Territories	8.5%
Export	27.0%

[1] Except small tonnages of special products.

Catalytic cracking installation at Frontignan refinery. The cracking chamber is at the middle of the column aligned to the left of the reactor. The catalyst distributor is at the top.

output exceeds national requirements

From May 1951 to April 30, 1952, the refineries treated 144 million barrels of crude petroleum.

During the same period, the national production of crude oil was 3,030,000 barrels (of which 1,830,000 came from the Lacq field), compared with 1,878,000 barrels in the preceding year.

This tonnage of production is still very small in comparison with French needs, but it is to be expected that if prospecting is maintained as contemplated, good results will be obtained both in France and the overseas territories, and that in years to come, the national production will supply an important fraction of the needs of the French refineries.

Imports of crude petroleum increased to 144,035,000 barrels from May 1, 1951 to April 30, 1952. Nearly the whole of the imported crude came from the Middle East, which furnished 90.2 percent of the imported tonnage, compared with 86.9 percent in the preceding year.

Of this total, 26,677,000 barrels represents the tonnage furnished by the Compagnie Francaise des Petroles as its share of the production of the Iraq Petroleum Co., an increase of 56.7 percent over the tonnage for the 12 preceding months. It is expected that this will soon be increased to 44,160,000 barrels.

Some 28.4 percent of the crude petroleum was paid for with 70,700,000 U.S. dollars, which covered purchases made by the subsidiary companies of the American group (N. J. Standard, Socony-Vacuum Francaise, Raffineries de Petrole de la Gironde) and by the companies which have no American participation (Compagnie Francaise de Raffinage, Raffineries de Petrole de l'Atlantique) for a part of their supply.

Payment in the amount of 45.8 percent (equal to $105,125,000) has been made to cover the needs of the companies with English participation (Cie. de Raffinage Shell Berre and Societe General des Huiles de Petrole).

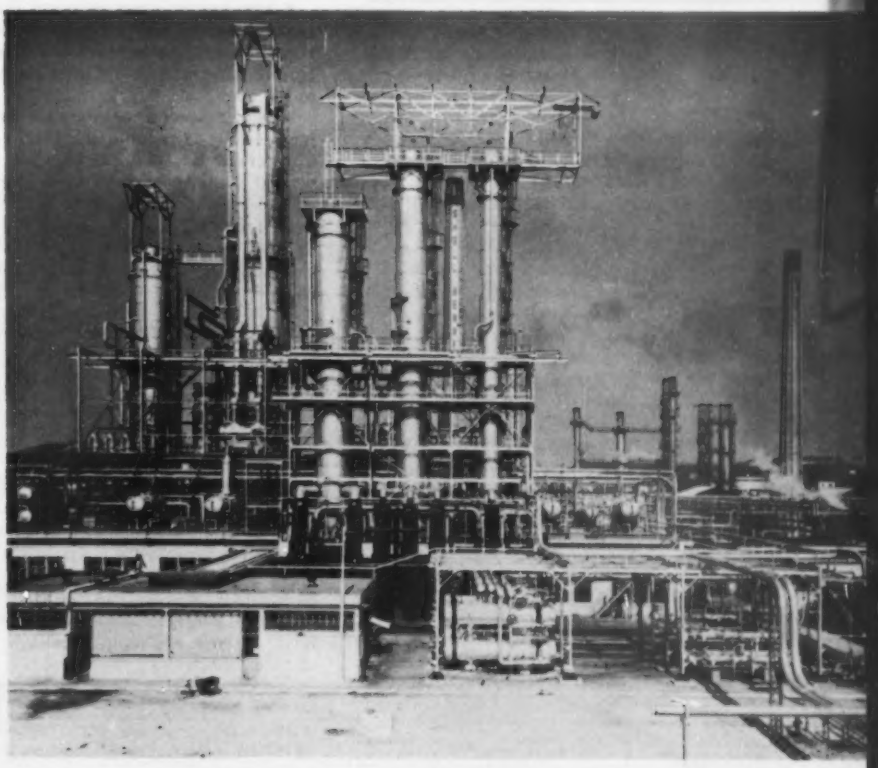
The payment agreements put into effect during the past year in order to reduce dollar expense have been continued. Under these agreements the crude petroleum furnished by the American companies from the Middle East has been paid for in the proportion of 75 percent in dollars and 25 percent in francs.

The French government earnestly wishes to raise this latter part to 40 percent, but it has always been frustrated by the difficulties encountered by the interested companies in using their francs on the French industrial market.

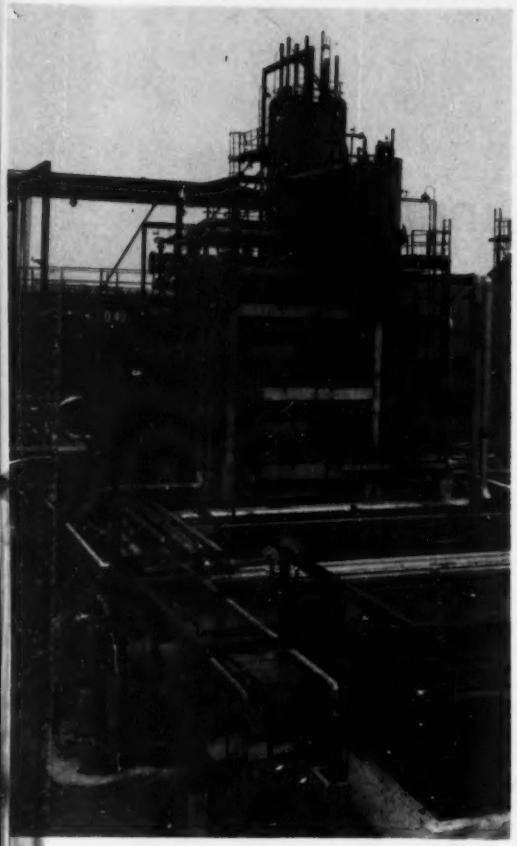
Especially to be noted is the remarkable progress made by the French petroleum industry in economizing on exchange. The IPC is able to foresee that by the beginning of 1953, it will be enabled, by agreements and by the increase of its own production, to pay about 50 percent of its purchases of crude oil in francs, as compared with 10 percent in 1949.

An analogous progress is shown in the matter of freights, due to the steady growth of the fleet of French tankers and also to reduction of maritime transport due to the inauguration of the Banias pipe line. It is estimated that at the beginning of 1953 more than 60 percent of the freight charge will be payable in francs, whereas in 1949 this percentage was 34 percent.

To complete this brief review of the financial aspect of the French petroleum problem, mention may be made of the increase of exchange reserves obtained by



Shell refinery at Berre. Topping installation is largest in Europe, 45,000 b/d.



Raffinerie de Gonfreville
MEK lube dewaxing plant.

use of the excess capacity of the refineries for work on special orders and for export.

However, certain special products cannot be made by French refineries, and it has been necessary to reduce the importation of certain finished products. This has been true of aviation gasoline of 100/130 O.N., certain categories of lubricants, small tonnages of gasoline of very high octane number, paraffin, and petroleum coke. On the other hand, in the very near future it will not be necessary to import lubricants.

Some new installations are about to be put in service at Gonfreville (Cie Francaise de Raffinage) at Dunkerque (Societe Generale des Huiles de Petrole), and at Port Jerome (Esso Standard). When these installations are finally brought into service within a few months, the annual production of lubricants by the French refineries will be 3,800,000 barrels and will be nearly sufficient to cover the needs of France and its overseas territories, with exception of certain special products.

This situation is all the more remarkable because nearly the whole range of these lubricants is produced from Middle East crudes. Evidently this result could not have been achieved without special refinery equipment requiring exceptionally costly investments.

A comparative examination of the consumption of various products shows the remarkable extent to which the refineries have been forced to adapt their production to the market.

Whereas gasoline consumption in 1951 increased by 12 percent over that of 1950, the increase this year has been only eight percent while the consumption of gas oil and fuel oil has increased 19 percent and that of heavy fuels for the interior market and bunkering has increased 24 percent. This latter item, which in 1950 was 162 percent of the consumption of gasoline, in 1951 represented 175 percent.

This phenomenon, common to all the countries of Western Europe, of a very important relative increase in the need for fuels in comparison with the need for gasoline, is the core of the problem which the French refineries must face in the coming years.

It is very likely that the public authorities will have to revise the policy they have been pursuing of constantly increasing the tax on gasoline and adopt instead a program of detaxation adapted to favor an increase in the consumption of this product. Refineries may then balance their products and assure the production of fuels sufficient for the country's needs without being forced to gamble on the export of gasoline.

As in last year, the ordinary automotive fuel put at the disposition of the automobilists had an octane rating of 70 (motor method); the super gasolines, pure or in a ternary mixture (gasoline, alcohol, benzene) had octane numbers between 80 and 86 (research method).

The French refiners are carrying on their program of improving the quality of their fuels, and on May 1 of this year the octane number of super gasolines delivered from the refineries reached 84 (R) as compared with 81 last year.

As regards installations and equipment, the year 1951-1952 has been mainly characterized by completion and initial operation of the following:

(1) New units for production of lubricants: three units for de-asphalting by propane, three units for de-paraffining by solvents, two units for refining by furfural, and several units for contact treatment. Due to these installations, the capacity for producing lubricants will soon reach about 3,800,000 barrels a year.

(2) A new unit for atmospheric and vacuum distillation.

(3) A catalytic cracker.

(4) A new refinery (Dunkerque).

(5) Various other units, including one for thermal reforming.

The principal works remaining to be completed are four catalytic cracking installations which will be put into service in 1953. The total catalytic cracking capacity will then be about 55,000 barrels per day.

All told, this investment in equipment by the French refineries has required the expenditure of $23 million, of which $16 million consisted of ECA funds, on a total cash investment exceeding $200 million.

Below is given in more detail the program of work executed by various refineries during the fiscal year 1951/1952, with mention also of projects in course of realization.

Compagnie Francaise de Raffinage: At the Normandie refinery at Gonfreville, the construction of units for the production of lubricants (approved by ECA in 1949) has been entirely completed. The plant comprises a unit for de-asphalting with propane, put in service in the fourth quarter of 1951; an MEK dewaxing unit, in service; a unit for refining furfural; and a unit for clay treatment. These last three are in service. Altogether they will produce 830,000 barrels of lubricants per year.

Among the works under construction, there is an installation for collecting and reforming cracked gas, and a remodeling of a blending plant to be finished in 1952. With equipment actually available, this refinery has capacity for processing 71,000 barrels of crude oil a day.

Refinery La Mede, in Provence: The main construction includes a 10,000 b/d catalytic cracker approved by ECA in June 1950 to be finished by April 1953 and a propylene fractionator to be finished this year. In both refineries the utility and storage facilities have been remodeled and extended.

TABLE I

CRUDE RUNS TO REFINERIES

May 1, 1951 to April 30, 1952

	Thousands of Barrels	Percent
Middle East		
French participation (Iraq)	20,677	14.0
Other origins	111,531	76.2
Western Hemisphere		
U. S. A.	640	0.4
Venezuela	10,170	6.9
Other sources	1,017	0.7
National Production	2,463	1.7
	146,498	100.0

TABLE II

DELIVERIES BY REFINERIES

May 1, 1951 to April 30, 1952

Propane	26,500	metric tons
Butane	175,500	" "
Gasolines	36,635,000	barrels
White Spirit	498,000	"
Turbine fuel	646,500	"
Lamp oil	2,768,000	"
Gas Oil	33,346,700	"
Fuel Oil	51,866,500	"
Lubricants	2,397,000	"
Bitumens	721,000	metric tons
Paraffins and petrolatum	12,255	" "
Paraffin distillate and misc. products	372,900	barrels

Compagnie de Raffinage Shell - Berre: At the Berre refinery, where the crude capacity has been raised close to 60,000 b/d due to a new topping unit, the principal work under construction is a new 10,000 barrel catalytic cracker approved by ECA in September 1951, which will come into service by the middle of September 1953. A new unit for thermal reforming was put in service in September 1951. Utilities and storage have been expanded.

Petit-Couronne refinery now has a crude capacity of 49,000 b/d. Various works were completed in 1951/1952, including a reforming unit (September 1951). A new 14-inch pipe line for bringing crude oil from Havre was put in service in February, 1952. The detergent (Teepol) plant of the Societie Shell-St. Gabain, which is located alongside the Shell Berre refinery, was put in service in October 1951.

At Pauillac, work is proceeding to double the distillation equipment (the present capacity is 7,000 b/d). Completion, including an extension of storage, is scheduled for the fourth quarter of 1952.

Societe Generale des Huiles de Petrole B.P.: At Dunkerque, a major part of the new installations was completed in the fourth quarter of 1951. Among the new units may be cited a 26,000-barrel topping unit (in service October 1951) and a thermal reforming plant (November, 1951.) Plants for refining with furfural, MEK dewaxing and for clay treatment were put in service at the beginning of 1952.

The production of various lubricants will amount to about 380,000 barrels a year. The refinery includes equipment for gasoline fractionation and for the manufacture of bitumens and paraffins. Capacity of the refinery is about 39,000 barrels per calender day.

At the Raffinerie de l'Avera, where the present crude capacity is 39,000 b/d, the principal work consists of various improvements and construction of tanks. Construction and equipment of the plant of the Societe Naphthachimie, located alongside the Avera refinery, is being pushed. As previously stated, this plant will manufacture acetone, glycols, and various solvents and sundries. The raw materials will be supplied by the Avera refinery.

Esso Standard, the Port Jerome refinery: The new units for propane de-waxing and propane de-asphalting were put in service in the last quarter of 1951. These units will bring the production of lubricants up to about 960,000 barrels a year. The construction of a unit for preparing charges for catalytic cracking was finished in the first part of 1952. During 1951-1952 the power house, the laboratories and various utilities have been improved and extended. Among projects in execution is a 10,000 - barrel catalytic cracking unit, approved by ECA in June 1950, to be finished by April 1953. The present capacity of the refinery is now 53,000 barrels per calendar day.

Raffineries Francaises de Petrole de l'Atlantique: The new topping unit was put in operation in July 1951 and has raised the refinery's capacity to 25,000 b/d. A new vacuum distillation unit was put in operation in the third quarter of 1951. The principal works in progress are construction of a 10,000 b/d catalytic cracking unit approved by ECA in September 1951, which will be ready by the middle of 1953, and various adjuncts to the refining process.

Raffineries de Petrole de la Gironde: At Ambes, the work executed during 1951-1952 consisted of various improvements. The capacity of the refinery, which was put in service in February 1950, is 17,000 b/d.

Pechelbronn SAEM: The Merkwiller refinery, with a capacity of 17,000 b/d, is working on crude oil extracted from the deposit at Pechelbronn. Construction activity is limited to improvements and current maintenance.

Socony-Vacuum Francaise, refinery at Notre-Dame-de Gravenshon: The new lubricant units were put in service during the fiscal year 1950-1951. During 1951-1952 the company made certain improvements, extension of utilities, and tank-storage. The capacity of the refinery is 17,500 b/d.

At the Frontignan refinery a new 10,000-barrel catalytic cracking unit was put in use in September 1951. Various improvements have been effected in the power house and other utilities. The treating capacity of the refinery is now 25,000 b/d.

To complete this enumeration, mention may be made of the continuation of the work of improving the port of l'Avera, at the entry of the Etang de Berre, where the rocky pass will be deepened to 36 feet by the end of 1952 and the first wharf with two berths will be available in the summer of this year.

It is estimated that the Le Havre-Paris pipeline, which will bring white refined products made by the refineries of Basse-Seine to the Paris region, will be in operation by the end of 1952.

Socony-Vacuum refinery at Notre-Dame de Gravenchon, near Rouen on the Seine 30 km. from Le Havre, with a capacity of 800,000 tons, produces lubricating oils and greases.

BY T. R. SHAW

FACTORS IN THE DESIGN OF REFINERY ELECTRICAL DISTRIBUTION SYSTEMS

THE MODERN REFINERY'S electrical system usually amounts to an investment of about ten percent of the total plant cost. This is higher than in most industries because of the precautions that must be taken in some areas where explosive vapors might be present.

To design an adequate system, the electrical engineer must first develop a master plan for what is considered the ultimate refinery size in order that allowance may be made for future expansion. Failure to provide for expansion results in future extravagance. Many changes in process also demand that the electrical distribution system be flexible.

Each Phillips Petroleum Co. refinery has a master plan which is revised yearly. The engineering department works five years ahead of construction and estimates probable requirements as much as ten years in advance of the date at which the plan is revised.

Once a master plan is developed, the electrical engineer has a basis on which to erect his system in accordance with sound principles. First he must design a safe system. Second, he must consider economics. This includes designing for adequacy and reliability.

The electrical system must be kept as simple as possible. Modern electrical equipment is well designed and practically trouble free, but making the system complicated may result in unnecessary shutdowns. Experience has proven that in times of emergency more mistakes are made in switching complicated systems than simple, straight-forward systems. Simple systems are easier to understand and therefore easier to operate during both normal and abnormal conditions. Another fact in their favor is the growing difficulty of securing properly trained and experienced personnel.

Service reliability in modern refinery processes is also a necessity. In refinery or hydrocarbon processing plants engineers can achieve the ultimate in service reliability only by using the highest grade electrical equipment, the best installation methods available, and qualified personnel. All three are equally important.

Unit substation 13,200 volts to 480 volts.

The refinery electrical distribution system should be designed and engineered to enable maintenance work to be performed on de-energized circuits without interrupting service. The highest grade electrical equipment on the market requires preventive maintenance, and a well scheduled program is a necessity to insure service reliability. This can best be obtained by dual circuits and the use of drawout equipment.

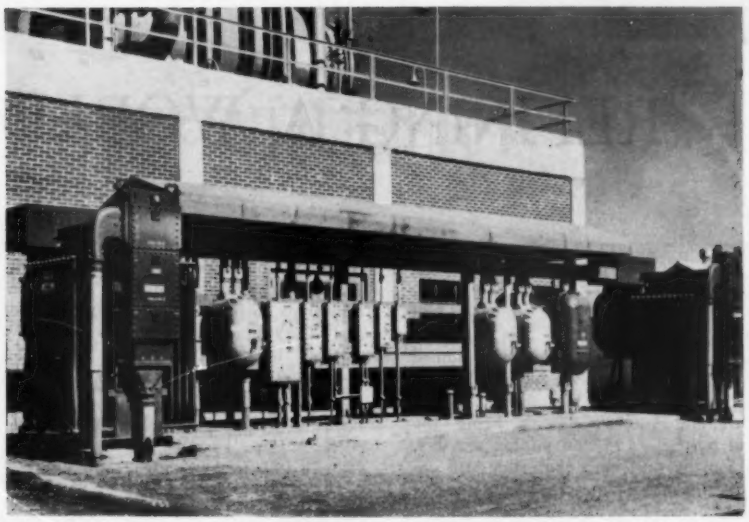
Ten points should be considered in designing the electrical distribution system, according to General Electric's "Industrial Power Systems Data Book." They are:

1. Nature and magnitude of the load.
2. Source of power.
3. System cost.
4. Voltage levels.
5. Circuit arrangement.
6. Most economical substation size.
7. Short-circuit protection.
8. Overcurrent protection.
9. Grounding.
10. Secondary distribution.

Considering the first point, the bulk of refinery load is composed of integral horsepower polyphase induction motors. Although usually placed in group locations, these often are rather widespread. The nature and magnitude of loads are ideal for the primary distribution unit substation type of load centers.

To estimate load magnitude in early

Tom R. Shaw joined Phillips Petroleum Co. in 1937 after graduation with a degree in electrical engineering from Kansas State College. His first work was at the Kansas City refinery in the electrical and instrument section. In 1939 he was transferred to company headquarters at Bartlesville to do refinery design work. In 1942 he was made assistant chief electrical engineer and in 1948 was promoted to head of his department.



Double ended 2,000 KVA unit substation.

stages of plant design, the electrical engineer must work closely with process groups, operations and management. After information is gathered from the various sources, the experienced engineer will evaluate his data and develop a master plan for the selection of equipment with ratings adequate for the future of the plant. A close estimate of running loads and maximum demand in the petroleum industry is more difficult than in many other industries because service reliability is so important and for that reason a great deal of standby equipment is installed.

Considering point two, the source of power will have a decided influence on voltage selection. If it is necessary to build a power plant, the most desirable voltage can be selected. If power is to be purchased and the voltage of the incoming line is above 15,000 volts, voltage can still be selected. However, if the utility voltage is below 15,000 volts, economy may dictate designing the system for this voltage. By operating at the utility company voltage, one set of voltage transformers and associated equipment can be saved. There are some refineries and chemical plants where the magnitude of the load is such that it is desirable to operate the system at a voltage in excess of 15,000 volts. However, this is an exception. As a rule, it is more desirable, both technically and economically, to use some voltage below 15,000 in refinery distribution systems.

Point Three: To determine the electric power system cost, management will require estimates on the most desirable electrical distribution system for the plant as well as estimates on alternate systems. The electrical design engineer should make the estimate realistic to be sure he will not have to cut corners to stay within the appropriation.

Point Four: In selecting utilization voltage, the load magnitude and distance do not govern the selection nearly as much as utilization equipment available, safety and codes and standards. The selection of voltage can be very readily broken down into three basic classes which are: (1) voltages of 600 or less, (2) voltages from 2,400 to 15,000, and (3) voltages above 15,000. Since the major part of the refinery load consists of integral horsepower polyphase induction motors, 480 volts is generally recommended for refinery work.

The 208Y/120 volt system is more economical than other voltages in the 600-volt class when 50 percent or more of the utilization equipment is operated at 120 volts and the load is above 50 KVA. This condition is not encountered in many refinery areas. However, in office buildings, in specialty plants, and in compounding and blending plants, the 208Y/120 volt system should be considered.

There is very seldom any reason for selecting 240 volts. If 240 volts can be used, 480 volts can be used more economically since the 240-volt load center systems cost about 40 percent more than 480-volt systems. Some plants try to justify 240-volt systems from a safety standpoint. However, any voltage above 50 volts can be fatal, and good grounding and safety practices should be followed in designing and working on circuits of either 240 or 480 volts.

In general, 600-volt load center systems cost from two to seven percent less than 480-volt systems. The 600-volt systems have not been popular in refineries,

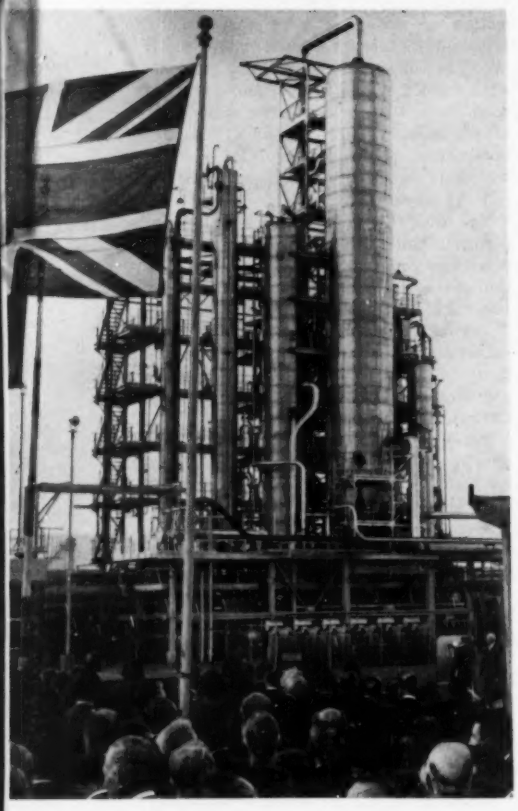
(Please turn to page 156)

Sir William Fraser, left, chairman of Anglo-Iranian Oil Co., and R. Meganck, managing director of BP Belgium, conversing at the June 23 official opening of the new 40,000-barrel refinery at Antwerp built by Compagnie Financiere Belge des Petroles, S.A.

Santiago Vera, Venezuelan Minister of Mines and Hydrocarbons, pushes a lever to activate Shell's new $25 million lube plant at Punta Cardon.

Broad construction activity makes

REFINING A WORLD



General view of the opening ceremonies at the new Antwerp refinery.

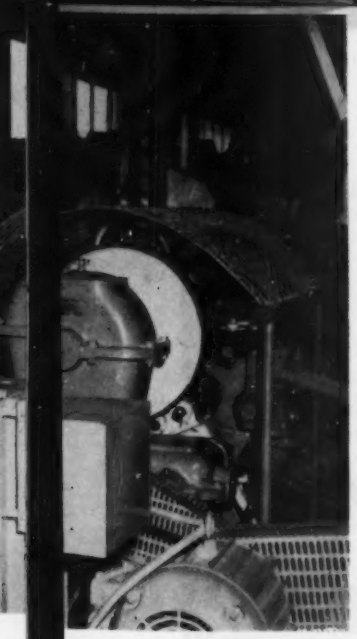
SIGNIFICANT FEATURES in the progress of the refining industry during the year now ending are the notable accretions to processing capacity and the still more extensive plans for new construction and plant enlargement now planned that will make themselves felt in 1953 and later. Additions to throughput capacity of roundly 700,000 barrels bring the world total close to 13.5 million per day, and for the first time the crude still capacity of plants outside the United States has risen above six million barrels daily.

Even more significant is the extent to which new refinery locations are spread around the world, making this phase of oil operations a truly global industry. Numerous new plants are under way in the Middle and Far East and in Oceania to match the activity in Europe and in North and South America, with the result that the connection between areas of production and marketing and centers of refining is becoming much closer than in the past, and the international character of the oil industry as a whole is becoming more pronounced.

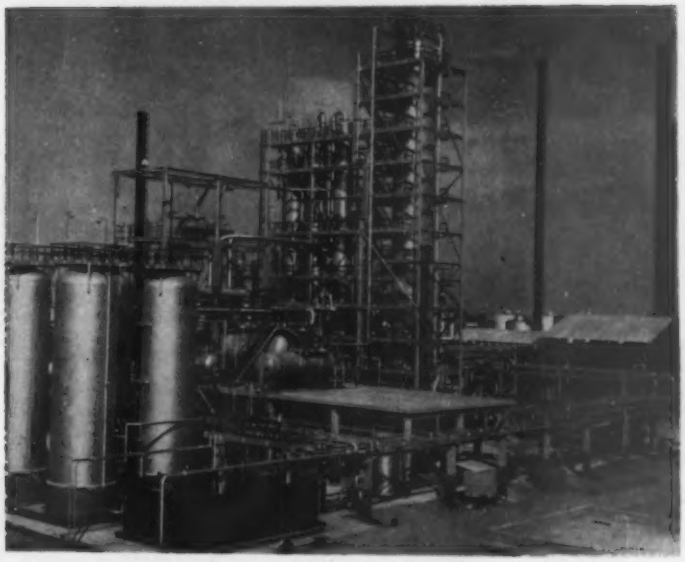
On other pages of this issue, reports on refinery developments in France, Germany and Italy show that plant capacity in each of these countries now equals or exceeds the requirements of domestic consumption. The same is true of the United Kingdom. In addition to the contributions to product supply by the Kent and Coryton refineries elsewhere described, important additions are being made to other British refineries which will raise total capacity above the 20 million tons yearly which was considered necessary to free the country from dependence on imported products. Consumption of oil products during 1951 is calculated at roundly 21 million tons.

The past year has witnessed the virtual completion of Shell's post-war refinery expansion program in the U.K., and production from its refineries is now over 8.5 million tons per year. Stanlow North, the pre-war section of the Stanlow refinery, which manufactures bitumen, lube oils and industrial oils, has a total capacity of 15,000 b/d of combined asphaltic, paraffinic and various minor feed stocks. In Stanlow South, the new section of the refinery, the main event of the past year has been the completion of the second distillation unit which raises the crude capacity to 3.75 million tons annually. A vacuum distillation unit and a feed preparation unit for cat cracker feed stock also were completed. Early this year the fluid cat cracker with a capacity of 25,000 b/d came into operation.

A plant for the recovery of elemental sulfur at the rate of 10,000 tons per



Furfural extraction unit forming a part of Shell's new lube plant in Venezuela which went on stream in June.



WIDE INDUSTRY

year is now in operation and a sulfuric acid plant is in course of erection. Modifications have been made in the bitumen plant, in order to enable Middle East crudes to be processed instead of the Venezuelan feed stocks hitherto imported. The olefins from the thermal reformer and cat cracker gas streams are used in part as feed stock for the chemical plant while the balance is polymerized for the production of polymer gasolines.

At Shell Haven East, the pre-war refinery, some units are being revamped in order to handle the short residue from the new section of the plant for the manufacture of bitumen. Solvent treated lube oil is also made in the old plant. The new Shell Haven West refinery is now complete, with its 60,000 b/d crude distillation unit, reforming unit and vacuum distillation plant for the production of short residues of 300° penetration, which are pumped through a steam jacketed line to the old refinery.

The original aviation gasoline refinery at Heysham, purchased from the British government in 1948, has been revamped for distillation of Middle East crude with a capacity of 37,500 b/d.

Throughput of Anglo Iranian's ever-growing Llandarcy refinery was pushed up to a rate of four million tons per year during the year and the plant is now working at that capacity. Construction of the catalytic cracker is well advanced and it is expected to come on stream in December. Work is also proceeding on the new lubricating oil plant.

Completion of important parts of the company's modernization program at Grangemouth, including the commissioning of a new 30,000 b/d distillation unit in March, has raised the capacity of the refinery to 2,250,000 tons of crude per year. A new boiler house and power station was put into commission in April. This plant consists of four Spearing boilers, each with a capacity of 150,000 lbs. of steam an hour at a pressure of 500 lbs. Normal firing is by oil, but gas can be used. In addition to driving three turbo-generators with a combined installed output of 18,750 kw, the steam is distributed to the various process units at 200 psig while power and steam are supplied also to the neighboring factory of British Petroleum Chemicals, Ltd. Electric supply sufficient to meet the demands of both factories is distributed at 11 KV to a number of area substations, where it is stepped down to 3.3 KV for large motors, and then stepped down to 440 volts for smaller motors.

Two venturi reinforced concrete cooling towers, each of which has a capacity of 1.5 million gallons per hour, are used for cooling the power plant water. Crude oil for this refinery will, in the main, be discharged at the new 57-mile pipe line terminal at Finnart, Loch Long, where there is suitable deep water close offshore, although tankers up to 12,000 tons can be discharged at the Grangemouth jetties. Cuts from the primary distillation unit are light gasolines which pass to the de-propanizer and de-butanizer towers where propane and butane gases are drawn off, the latter being treated with tannin solutizer solution before bottling. Cuts from the main tower include motor spirits, naphtha, kerosine, light and heavy gas oil with a fuel oil residue. The last three products are blended for fuel. The light gasoline from the first two towers and the motor spirit overhead from the main tower are caustic soda treated and finally copper chloride sweetened.

The naphtha, together with a proportion of the motor spirit, is caustic soda washed and then goes to the cracking plant of the chemical factory adjoining as feed stock. The kerosine fraction is first bauxite treated, and then passes to the Edeleanu plant for SO_2 solvent treatment. The raffinate is treated with acid and soda and refiltered through bauxite for production of ordinary and premium grade kerosines, while the extract is redistilled, treated with plumbite and used as a blending stock for vaporizing oil. Cracked spirit from the chemical plant is returned to the refinery for treatment and blending with the treated motor spirit.

The new 10,000 b/d catalytic cracking plant and its auxiliary plants are expected to come on stream in September. Plant for the manufacture of white or

Bringing in a 96-ton reactor for Anglo-Iranian Oil Company's cat cracker at Grangemouth, Scotland.

solvent spirit is scheduled for addition in the future.

Construction and foundation work on the plant has presented many problems, as the site is on marshy ground, lying only a few inches above the high water mark of the adjacent Firth of Forth.

Increasing market demands have necessitated enlargement of the plant of Manchester Oil Refining Ltd., and its throughput is being increased to 150,000 tons per year. This expansion entails the construction of a new 3,500 b/d atmospheric distillation unit, to work in conjunction with the existing vacuum distillation unit. Completion is scheduled for November 1952.

The solvent extraction plant of the refinery comprises a solvent extraction unit and a continuous dewaxing unit. The chemical treatment plant is being enlarged to provide a higher production of lubricating and technical white oil.

At its Ellesmere Port refinery, Lobitos Oilfields Ltd. is installing a new Unisol gasoline treating plant which is expected to come into operation next year. Wm. Briggs & Sons Ltd. has installed a vacuum distillation unit for the processing of Venezuelan reduced crude for the production of diesel oil, jute batching oil, lubricating oil and bitumen. The unit was constructed by A. & F. Craig & Co. Ltd.

Work on the enlargement of the great Fawley refinery of Esso Petroleum Ltd., opened last year, is going forward. Construction of the polymerization plant for the catalytic cracker gases is nearing completion. The de-butanizing and de-pentanizing towers are finished, and the reactors and the de-benzinizing towers are nearly complete. Work on the erection of the lubricating oil treatment plant has begun as has the erection of the sulfur recovery plant. Further cooling water storage is being erected and is almost complete.

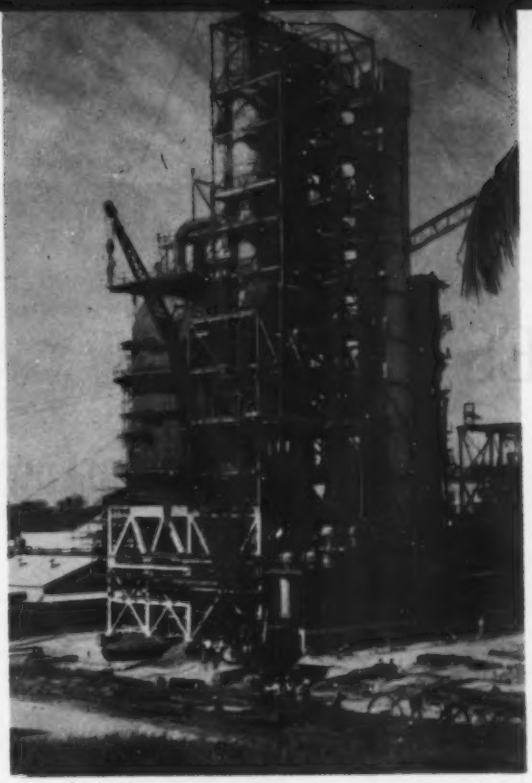
On the continent, the refinery of Soc. Industrielle Belge des Petroles at Antwerp, Belgium was completed and formally opened in June. The plant is jointly owned by Anglo Iranian Oil Co. and Petrofina and was built by M. W. Kellogg at a cost of $10 million. The plant is designed to handle 40,000 barrels daily when operating at capacity. Further expansion of the plant is planned.

Also at Antwerp, Esso Standard is building a refinery of 25,000 b/d capacity which will be ready for operation about June 1953. It will be equipped with a thermal reformer and a fluid catalytic cracking unit and is intended to operate on Middle East crude for the production of gasoline and fuel oils together with LPG.

A fluid catalytic cracking unit of 25,000-barrel capacity has been installed at the Pernis, Holland refinery of Royal Dutch Shell. The Pernis refinery of Caltex has been expanded by the addition of 8,000 barrels to its daily capacity. The plant is now operating at 28,000 b/d.

At Cartagena, Spain, the enlargement of the Refineria de Petroleos de Escombreras, S.A. to a capacity of 30,000 b/d is being carried on with anticipation of completion before December 1952. Ownership of the plant is shared by the Spanish government, CEPSA, and Caltex. In the Canary Islands, Cia. Espanola de Petroleo S.A. (CEPSA) operates a 20,000 b/d refinery which recently has been improved by the addition of a 5,000-barrel distillation unit, a furfural unit, an MEK solvent dewaxing plant and a propane deasphalting unit. In Portugal, "Sacor" has undertaken construction of a plant to include a 10,000 barrel topping unit, a 5,000-barrel cracking installation and a 2,500-barrel reforming unit.

From the Soviet orbit of Eastern Europe no reliable information is available. Based on estimated production of roundly 900,000 b/d by the Soviet Union and its controlled areas of Albania, Austria, Czechoslovakia, Hungary, Poland, and Romania, plus a possible synthetic output of 20,000-30,000 barrels, it would seem that refining capacity of 800,000 barrels or more would be required, but nothing has appeared to indicate any substantial addition to the satellite processing capacity of 150,000 barrels at the end



Cat cracker being built by Trinidad Leaseholds, Ltd., Pointe-a-Pierre, the first such unit to be erected on the island. Photo courtesy Foster Wheeler Corp.

of the war and any refinery construction within Russia is a closely guarded secret.

The Middle and Far East have been areas of particular activity in the planning of refinery construction during recent months. The strong desire of India to have a refining industry of its own has resulted in three specific projects for plant erection. One of these, undertaken by Standard Vacuum Oil Co., will provide a refinery of 25,000 b/d capacity to be located on Trombay Island in Bombay harbor with construction by The Lummus Co. Originally it was proposed to have a daily throughput of 19,000 barrels, but the desire of the Indian government to have available a larger supply of kerosine led to an amendment of the plans to make possible an annual production of 48 million gallons of kerosine. Completion date for the plant, originally set for 1956, may be brought nearer if materials are obtainable. The company has announced that William A. Williams of Montreal has been appointed chairman and managing director of a subsidiary now being formed to build and operate the $35 million refinery.

Another refinery to be built at Bombay is that of Burmah-Shell Refineries which is projected to incorporate crude distillation, catalytic cracking and bitumen blowing. A tentative figure of 40,000 b/d has been set for throughput capacity and the plant is planned for completion in 1956.

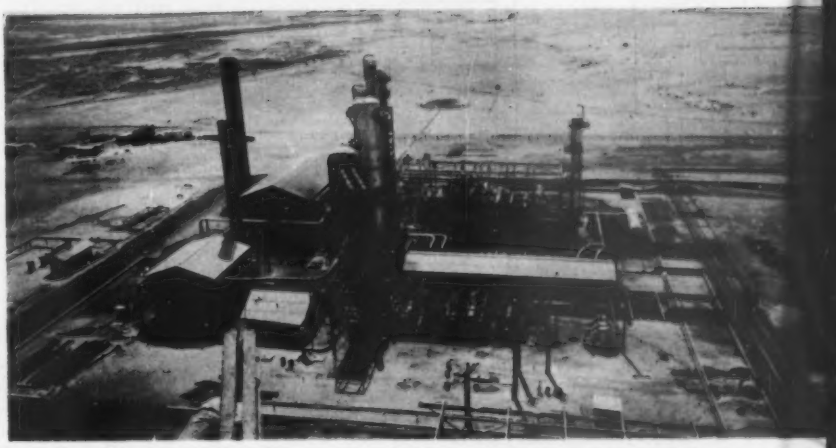
A third Indian refinery is sponsored by Caltex for a plant at Vingapatam, details of which have not been announced.

Pakistan is assured of a refinery by the offer of Burmah Oil Co. to erect a plant at Karachi of 11,000 b/d capacity in accordance with government proposals.

At various points in the Near East, new construction and additions to existing facilities are projected. Caltex has announced its intention of erecting a plant of 13,500 b/d capacity at Sidon, Lebanon, for the production of diesel and fuel oil. Most important new project is that of Anglo Iranian Oil Co. for a refinery of 103,000 b/d capacity at Aden. Bahrein Petroleum Co. is raising catalytic cracking capacity to 26,000 barrels daily at its refinery on Bahrein Island. The government of Iraq has arranged with M. W. Kellogg Co. for erection of a plant near Bagdad to supply domestic needs.

At Durban, South Africa, Standard-Vacuum has begun construction of a $17 million fuel products refinery of 15,-

(Please turn to page 138)

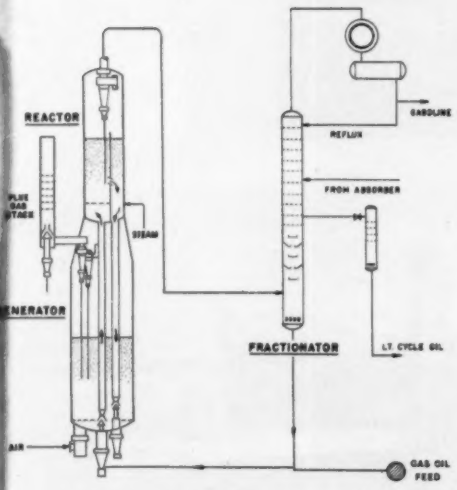


Crude unit at Bahrein Petroleum Co. refinery on Bahrein Island. The company is modernizing the cat cracker for which this unit prepares feed stock to increase charging capacity.

Josco terminal, Yokohama, Japan. Refinery operations on the island are being expanded rapidly to supply the nation's requirements. U. S. Army photograph.

CITIES SERVICE

operates first ORTHOFLOW CRACKER in United States



Principal elements in the Orthoflow cracker installed by Cities Service at Ponca City. Fresh feed is passed through a plug valve controlling the regenerated catalyst flow and enters the reactor mixed with regenerated catalyst.

FIRST COMMERCIAL units of the Orthoflow fluid catalytic cracking process were put into service during the past year. In the United States the first was built by M. W. Kellogg Co. for Cities Service Oil Co. (Del.) as part of the general modernization and expansion program undertaken by Cities Service at Ponca City, Okla. Earlier phases of the company's post-war program had included large construction projects at Chicago and at Lake Charles, La. The Ponca City work involved an increase of a third in throughput capacity plus the construction of the new 8,300 b/d cat cracker.

Ground was broken for the Ponca City Orthoflow unit in the spring of 1951, and it was ready for catalyst circulation within nine months. Plans for formal dedication ceremonies to be attended by Oklahoma state officials and company officers were set aside early this year when the nation-wide strike interrupted operations.

In the ten years since the first fluid cat cracker went on stream at Baton Rouge, La., there has been a constant evolution in design to simplify the structure and the flow of oil and catalyst. Latest of these is the Orthoflow. The name "Orthoflow" is derived from the Greek root "orthos," meaning straight or upright, and is intended to suggest the straightline flow through the composite regenerator-reactor.

Principal elements of the Orthoflow unit are reaction and regeneration vessels. These two vessels are combined one above the other in a single unit known as the Orthoflow converter. The reactor is located in the upper section of the converter with the regenerator occupying the lower position. A portion of the reactor vessel is employed as a catalyst stripping section.

Standpipes, through which oil charging stock plus steam and catalysts are fed to the reactor and the catalyst returns from reactor via stripper to regenerator, are positioned inside the converter.

Catalyst and oil introduced into the carrier line to reactor passes through a "needle" type valve. Hot catalyst from the bottom of the regenerator is drawn into the carrier line by pressure drop caused by high-velocity oil passing through the valves. Control of the valves is automatic, but valves are so located that they may be operated manually when desired.

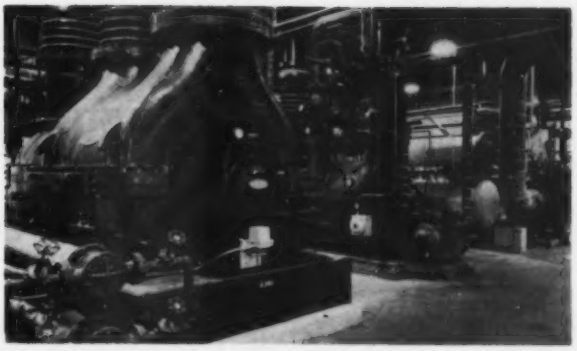
Circulation rate of catalyst through the system is controlled on the regenerated-catalyst side of the circuit, thus regulating temperature in the reactor.

Catalyst from regenerator to reactor supplies heat necessary to bring the oil feed to vaporization temperature, vaporize oil, and to offset heat of reaction.

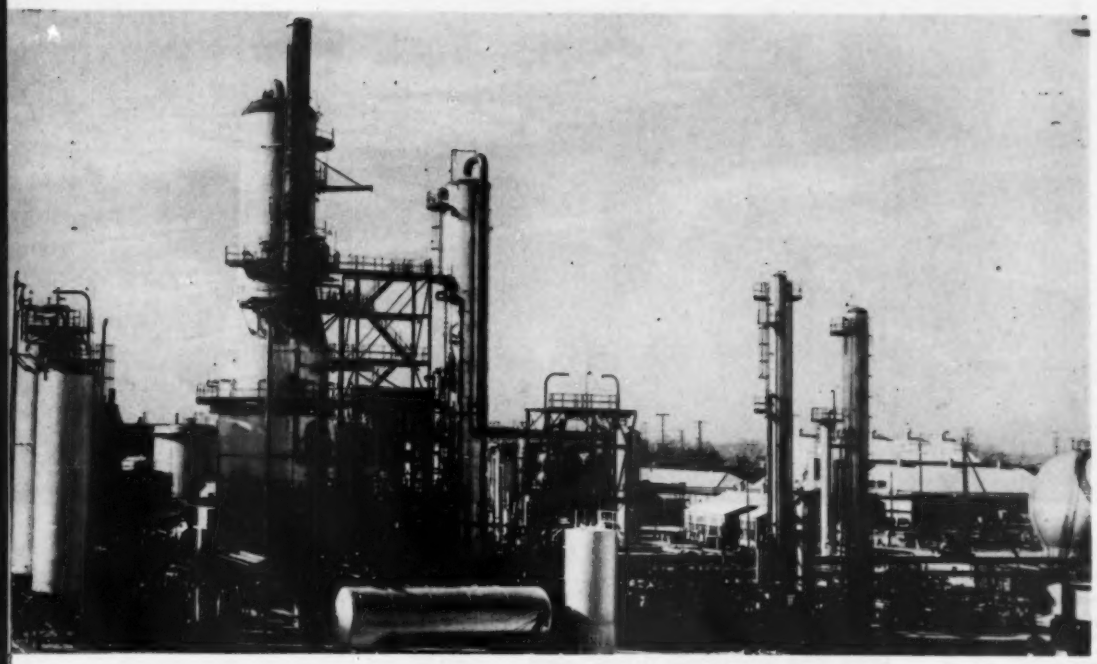
Advantages of the Orthoflow design include a reduction in erosion of lines, reduction in length of carrier lines, and a simplification of structure and foundations. Combining the reactor and regenerator into one vessel in some cases permits the use of only one internal head. No space between the two is needed for external lines. This permits a reduction in structure height.

An interesting feature of the design is the elimination of expansion joints in catalyst carrier lines. This is made possible by spring loading the special valves which control catalyst flow. The new valves are in essence large plug valves and thus are far different from the slide valves which control catalyst flow in most other fluid cat units. The new type "needle" valve through which catalyst and oil are introduced into the reactor feed lines is unique in that it controls the flow of regenerated catalyst while at the same time the entire oil charge passes through its hollow stem. The other plug valve controls the flow of spent catalyst from the reactor into the regenerator.

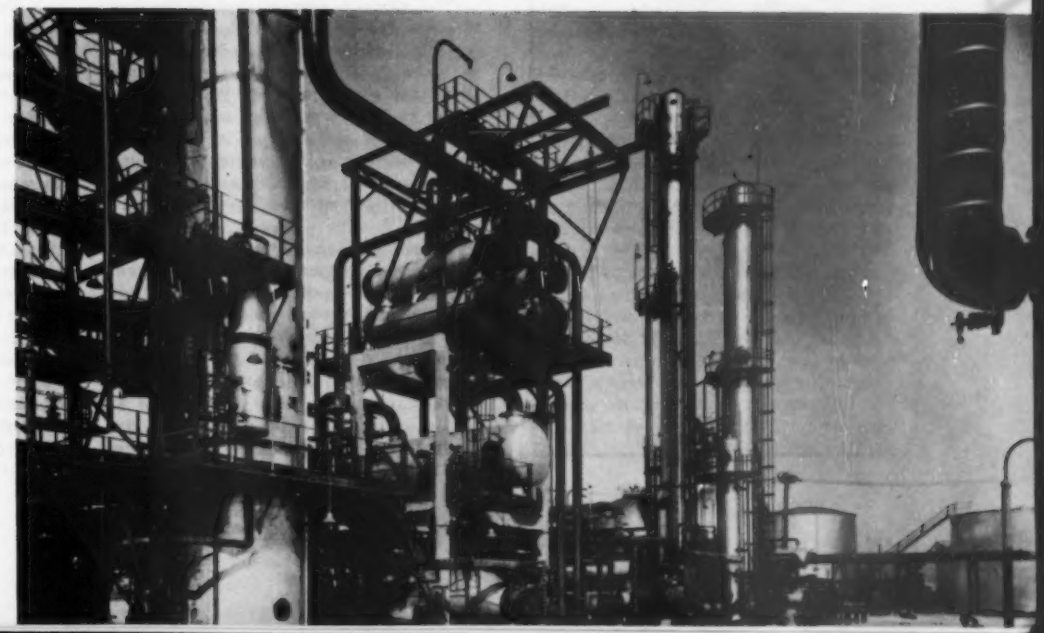
The third Orthoflow unit to be completed was installed at the new refinery of Canadian Oil Companies, Ltd., at Froomfield, Ont. Two others now are being built for The Pure Oil Co., and Atlantic Refining Co. has announced that it will build a 28,000-barrel unit at Philadelphia.



Air blower which supplies 26,000 cubic feet of air per minute for catalyst regeneration. Second unit is gas compressor for light ends recovery and third is the refrigeration compressor for gas recovery unit.



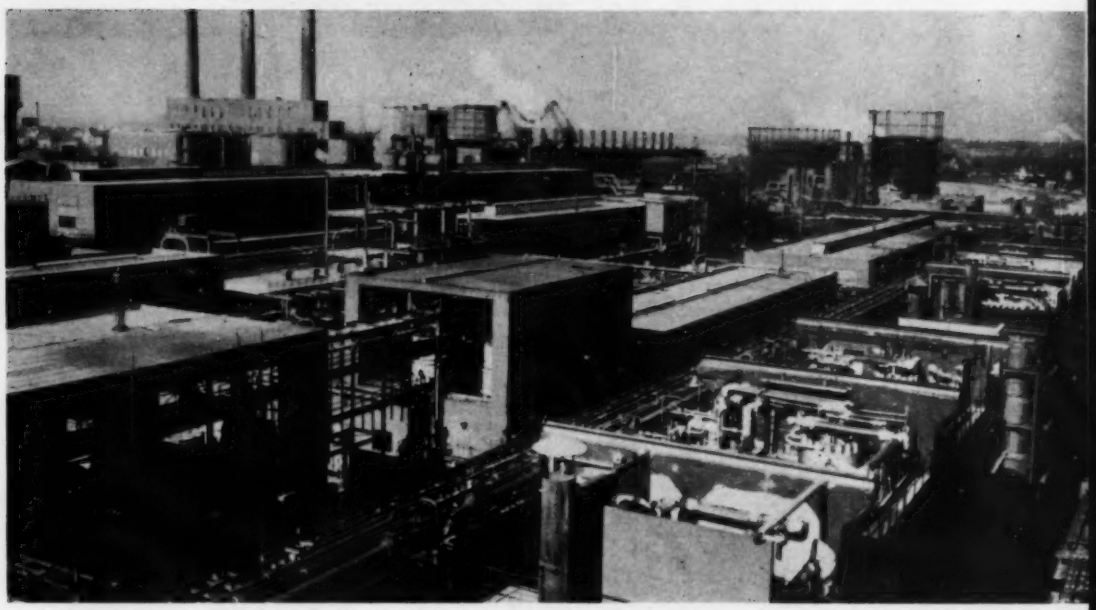
General view of Ponca City unit. Catalyst storage tanks are at left adjacent to converter, embracing both reactor and regenerator in a single column. Main fractionator is at right of converter and gas recovery section at extreme right.



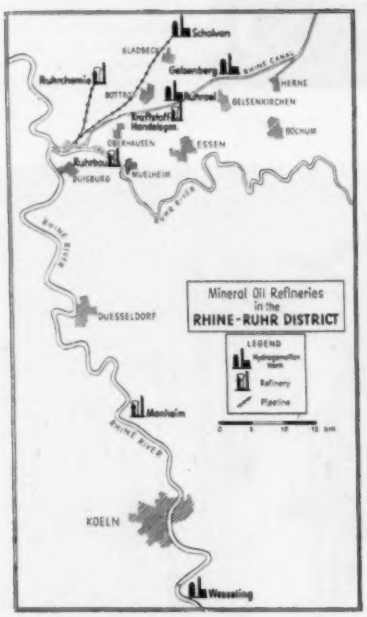
Base of main fractionator, exchanger condensers and gas recovery columns. A slurry boiler produces process steam in cooling fractionator bottoms.

GERMAN REFINERIES FULLY

Ruhr becomes refining center



Gelsenberg Benzin A.G. hydrogenation plant at Gelsenkirchen-Horst. Power plant and water gas production plant are in background, engine buildings and high pressure stalls in foreground.



Map showing location of Rhine-Ruhr district refineries.

By Alfred M. Stahmer

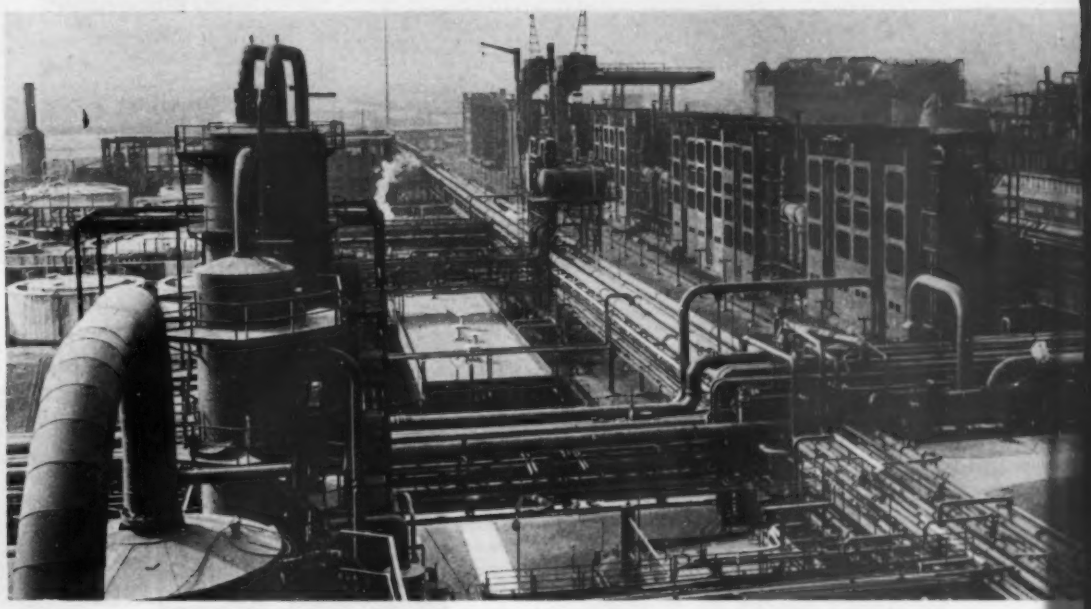
IN EARLY May the German Refiners' Association (AEV) decidedly unanimously to cut down the originally planned volume of crude oil imports in the second quarter of this year by 218,500 tons.

This decision was inspired by the fact that the growing refining capacity is now, if only slightly, above the local mineral oil demand. This results in part from the fact that consumption in Western Germany has not increased as rapidly in the first half of the year as it did in the period immediately preceding, mainly due to the increase of prices as a result of higher duties and taxes for gasoline and diesel oil.

Naturally there arose the question whether the refinery expansion program is over-dimensioned and likely to result in a surplus production which will call for an export outlet. This version, however, cannot be accepted. The upward trend of consumption is retarded mainly by fiscal measures which, according to the Minister of Finance, were unavoidable if the budget is to be kept in balance. Recent figures of gasoline and diesel oil sales (150,521 and 136,724 tons respectively in April) indicate, however, that a consumption of some 1.7 million tons of gasoline and about the same quantity of diesel oil can be anticipated for 1952, or 15.2 and 11.4 percent respectively more than in the last year. Assuming that the new treaty (Generalvertrag) between the United States, the United Kingdom, France, and Western Germany will be ratified, the setting up of German forces within the European Army will undoubtedly cause a further rise in mineral oil demand.

On the other hand, it is obvious that the refinery building program could not at every stage be paralleled by the consumption curve. Particularly in the case of the hydrogenation works in the Ruhr district, which started operating recently, there was a certain pressure to act immediately. By resuming production as soon as possible, further damage by rust and bad weather was to be prevented at those plants which had been partly destroyed

COVER DOMESTIC DEMAND:



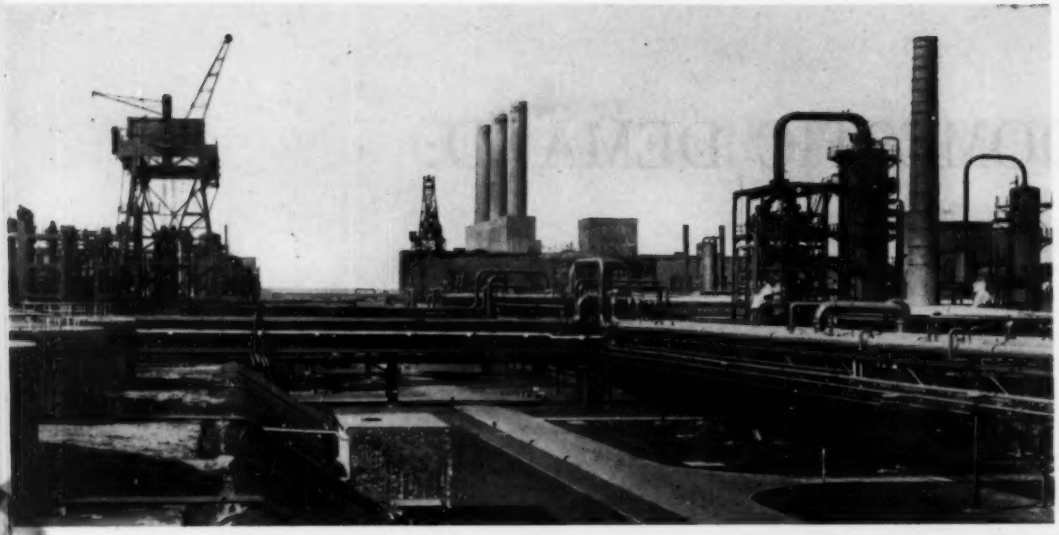
High pressure stalls at Gelsenberg Benzin hydrogenation works.

during the war. The refinery building program was intended to form a basis for a sufficient supply with indigenous products for a considerable future period. Doubtless the steadily growing demand will sooner or later reach again a target corresponding with the available capacity of the refineries.

In WORLD PETROLEUM'S report of September, 1951, the annual German crude intake capacity for 1952-53 was estimated to reach 6,340,000 tons. In the meantime the hydrogenation plan of the Ruhroel GmbH., Bottrop-Welheim, got the approval of the OEEC to treat 250,000 tons of crude oil annually. By this and other expansions and revisions the capacity figure has now gone up to 6,732,000 tons, or about 140,000 barrels daily. In comparison, the total consumption of the Federal Republic was 5,063,261 tons in 1951 and 1,245,284 tons in the first quarter of 1952 (the first quarter normally being 21 percent of the annual total). In actual fact, the refineries produced 4,560,695 tons of finished products in 1951 and 1,203,265 tons in the first quarter of 1952. The gap between the indigenous output of products and the consumption was filled by German benzole from cokeries; some oil distilled from brown coal tar and oil shale; by imports of finished products, particularly diesel oil, gasoline, fuel oil, and high grade lubricants; and finally by small quantities of test gasoline, bright stock, waxes, petroleum, coke, and vaseline. This year gasoline import will be cut down considerably, while diesel oil purchases from abroad will have to be maintained, as the refinery yield of this product cannot be stepped up to a certain extent without resulting in a surplus of gasoline and indigenous — that is, expensive — fuel oil which would find no market.

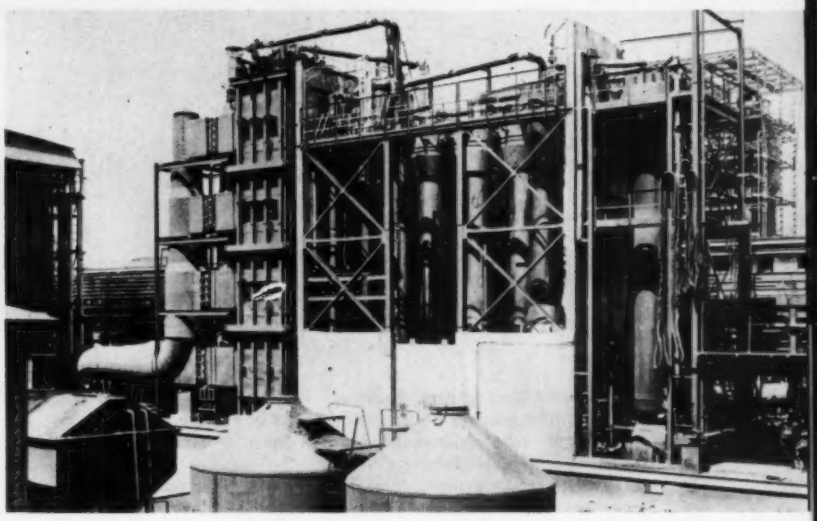
By the inclusion of the four hydrogenation works Gelsenberg, Wesseling, Scholven and Welheim in the refinery program, and the start of some topping plants, such as Ruhrchemie AG., Oberhausen; Ruhrbau GmbH., Muelheim; and Kraftstoff-Handelsgesellschaft mbH., Altenessen, the Ruhr area, main coal and steel producing district of Middle Europe, becomes a new center of oil processing. Hitherto the German refining industry was mainly concentrated in the import harbors Hamburg and Bremen. Hamburg in particular lost a large part of its hinterland when the Iron Curtain went down on the River Elbe. The bulk of oil consumption in the Federal Republic goes now to the Rhine-Ruhr district. Thus the hydrogenation works and refineries in the West, which started operating during the past two years, have the advantage of a nearby sales market. Furthermore, crude can be delivered by water either via Rotterdam up the Rhine or (from the Elmsland fields) via a canal system.

In 1951 Hamburg was still the import harbor for 56.2 percent of all crude from abroad. Rotterdam, receiving point for the Rhine-Ruhr district, handled 29.7 percent and the remainder was imported via Bremen and Antwerp. At that time 36.5 percent of the indigenous crude was delivered to the western refineries. In the current year the percentage will be more in favor of the plants on the Rhine and the Ruhr which from quarter to quarter increase their share in the total refinery output. At present 43.6 percent of the crude intake capacity in Western Germany is in the Rhine-Ruhr district. Ham-



Left, distillation units at Gelsenberg Benzin plant.

Below, high pressure hydrogenation chambers at Welheim plant of Ruhroel Gmbh.



burg has 30.5 percent, Hannover 11.8 percent, while Holstein, Bremen, Emsland and Southern Germany share the remaining 14.1 percent. As a matter of fact, Hamburg can expect a capacity increase by the end of next year or in early 1954, when the extension of the Esso plant in Harburg will cause a doubling of the present crude intake capacity of this refinery to 1,400,000 tons a year. About the same time the newly-erected refinery of Gewerkschaft Elwerath and Wintershall AG. in Lingen - Holthausen (Emsland) probably will start operating with an annual crude intake of about 400,000 tons. Expansion in the Rhine-Ruhr district will also make further headway. When summarized briefly, the situation at the main Ruhr plants is as follows:

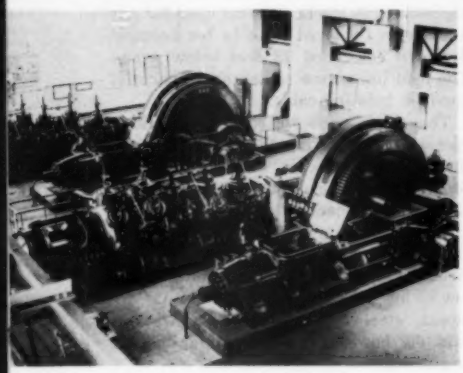
The hydrogenation works of Gelsenberg Benzin AG. in Gelsenkirchen-Horst, which processed 31 percent of German gasoline production in 1951, is now building a TCC cracking unit (Socony type), the erection of which was started early this year and which is expected to be completed in late 1953. The plant was projected by Hydrocarbon Research Inc., New York. Lummus-Lurgi will add a polymer gasoline plant. Later on, by a combination of hydrogenation and cracking, the production process will be made more flexible, yielding high octane gasoline. For the storage of crude, Gelsenberg has built two tanks with a capacity of 25,000 cu. meters each. A special foam extinguisher was constructed for the protection of these tanks. Socony-Vacuum, Standard of New Jersey and BP (Anglo-Iranian) provide Gelsenberg with indigenous and foreign crude oil.

Union Rheinische Braunkohlen Kraftstoff AG, expects to start, in October next, the new combination of cracking and hydrogenation in their plant Wesseling near Cologne. Wesseling, connected with Shell by a long-term agreement, is erecting a thermal cracking plant and additional reforming and polymer units which were all projected by Hydrocarbon Research, Inc. It is planned to crack the distillation residues first and to produce gasoline and gas oil from the cracking residues by high pressure hydrogenation. By applying certain catalysts, gasoline with a high content of aromatics can be produced. The quality of the straight run gasoline will be improved by means of a reforming unit. The polymer plant will be able to yield gasoline with an octane number of 100 to 110. The light hydrocarbons, in particular olefins, out of the reforming and cracking process, form a valuable basis for petrochemicals.

In the hydrogenation works Scholven, near Gelsenkirchen, owned by Scholven-Chemie AG. (affiliate of the state-owned Hibernia group), a different combination between the cracking and hydrogenation process is planned for the future. Scholven intends to build a Kellogg Orthoflow catalytic cracking unit. It is designed to split the distillation residue so that at the same time heavy gas oil from the vacuum distillation is cracked and the other residue is hydrogenated. In the second stage

General view of Wesseling refinery situated between Cologne and Bonn near the Rhine. Plant produced synthetic oil from brown coal during the war. It is now under lease to Shell and is running Kuwait crude. Shell photo.

AEG compressors for hydrogenation process at Welheim plant of Ruhroel Gmbh.



the cracking residues are hydrogenated and a small part of the hydrogenation products, namely paraffinous heavy oils, is transferred to the cracking unit. Apart from the treatment of crude oil, Scholven is refining benzole according to a newly developed catalytic pressure refining method. By this process, which is more efficient than the former sulfuric acid refining of benzole, a yield of 98-98.2 percent of sulfur-free refined benzole is attained. The present monthly throughput capacity of 12-13,000 tons crude benzole will be increased to 18-20,000 tons in due course.

The Bottrop-Welheim plant of the Ruhroel GmbH. (American Stinnes group) was the last one of the four hydrogenation works which were granted a production permit. Early in May Ruhroel started topping Aramco crude which is supplied by Caltex. In the second stage of rebuilding, Ruhroel will re-activate four high pressure chambers in order to hydrogenate the residue. In the meantime a reforming unit, developed by Ruhroel itself, will take up operations to improve the gasoline quality up to an octane number of 74. In this unit, which allows of a separation of the fraction up to 210° C, the gasoline will be desulfurized.

Ruhrchemie AG. Oberhausen - Holten, originally a Fischer - Tropsch synthesis plant, also took up crude oil topping when Allied production restrictions were lifted. A thermal cracking unit with Perco reforming is being built by the Koch Engineering Co. It is hoped that this unit will start operating by the end of this year. Then it will be possible to fully maintain the approved capacity of 250,000 tons crude intake annually. Recent research work carried on by Ruhrchemie resulted in development of the so-called Arge synthesis which is an improvement commercially on the traditional Fischer-Tropsch process.

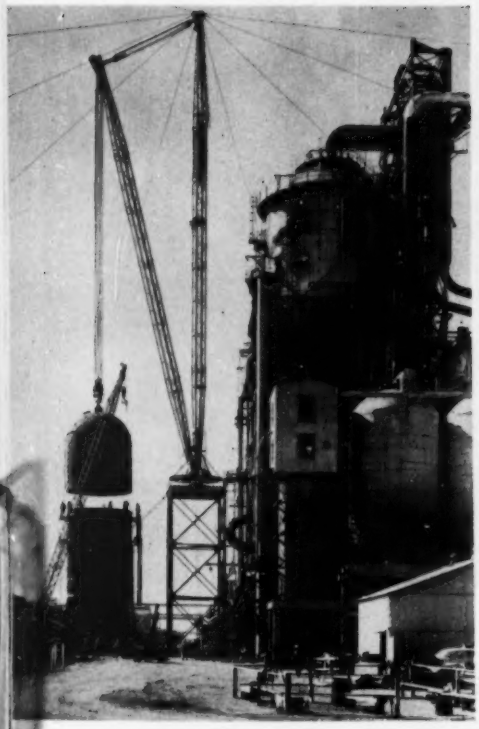
Early in 1951 the Ruhrbau GmbH., a joint interest of Hugo Stinnes OHG. and Braunkohle-Benzin AG. (Brabag), transferred the distillation unit of the former shale oil works at Balingen (Wuertemberg to Meulheim and started processing Aramco crude. To complete the plant a thermal reforming unit is being built. Proposals are pending either to introduce catalytic cracking or to set up installations for the production of petrochemicals.

REFINERY OUTPUT IN FIRST QUARTER 1952
(In Metric Tons)

Liquid Gas	18,025
Motor Gasoline	375,656
Special Benzine	29,397
	423,078
Lamp Kerosine	11,418
Motor Kerosine	1,541
	12,959
Diesel Oil	329,392
Lubricants	82,754
Bitumen	91,927
Fuel Oil	224,493
Other Products	38,662
	767,228
Total	1,203,265

CRUDE INTAKE CAPACITY OF OIL REFINERIES 1952
(in Metric Tons)

Badische Anilin- & Soda-Fabrik	48,000
BP Benzin- & Petroleum-GmbH. (AIOC)	660,000
Deutsche Erdoel-AG.	210,000
Deutsche Gasolin AG.	120,000
Deutsche Shell AG.	490,000
Deutsche Shell AG.	200,000
Union Rheinische Braunkohlen Kraftstoff AG.	800,000
Deutsche Vacuum Oel AG. (Sccony-Vacuum)	600,000
Esso AG.	700,000
Gelsenberg Benzin AG.	800,000
Gewerkschafte Deurag-Nerag	527,000
Georg Greiser/Pfeifer	24,000
Kraftstoff-Handelsgesellschaft mbH. (Schleweck Bros.)	35,000
Mineraloel- & Asphaltwerke AG.	60,000
Mineraloelwerke Albert Sengewald	42,000
Oelwerke Julius Schindler GmbH. (AIOC)	200,000
Mineraloelwerke Peine	18,000
Ruhrbau GmbH.	200,000
Ruhrchemie AG.	250,000
Ruhroel GmbH.	250,000
Scholven-Chemie AG.	400,000
Wintershall AG.	90,000
Zeller & Gmelin	5,000
	6,732,000



With cells and cyclones all installed, the top section of Shell's new reactor is lowered into place preparatory to welding the last seam. Photos courtesy C. F. Braun & Co.

CAT REACTOR REPLACED

during normal turnaround

EARLY THIS SPRING, engineers and construction men hung up what is thought to be a world's record for a major replacement in one of the country's big cat crackers. During a normal turnaround, a picked crew lifted out the ten-story reactor from a fluid unit, replaced it bodily with a new 200-ton counterpart, and put the plant back on stream, all within 28 days from shutdown to startup.

Locale of the feat was the Shell Oil Co. refinery at Dominguez, Calif., where the fluid unit was rounding out almost a decade of year-round operation. The reactor, heart of the high octane gasoline process, had gradually deteriorated over the years from intergranular corrosion. Nine months before, the Shell engineers had estimated that the big vessel would pass its limit of safety during the following year.

The size and weight of the vessel—25 feet diameter, 200 tons—posed a most difficult problem as to the method of replacement. The high value of down-time made speed a necessity. Early plans called for abandonment of the old reactor, and replacement with a new chamber mounted apart from the main structure adjacent to the fluid unit, but lack of space and the long down-time made this plan unsuitable.

Final plans called for the building of a new reactor within reach of the unit while the cracker was operated on its regular run. The plans depended on the use of some of the heaviest rigging equipment in the construction industry. A 200-ton guy derrick towering 24 stories above grade was needed to lift the old reactor out of the structure and to put the new completely fabricated vessel into the empty cavity.

Shell had engaged C. F. Braun & Co. to handle the whole project, planning, procurement, fabrication, and the big lift change over. Schedules were set to make the replacement during the regular annual spring turnaround. Weeks of intensive engineering and planning laid the groundwork for the fabrication and construction activities.

The new reactor was built of chrome-moly alloy steel, ASTM A-301, Grade B. Shell courses were ¾ inch thick, the hemispherical top head was ⅝ inch thick, and the conical bottom head ¾ inch thick. Shell courses and large sub-assemblies were fabricated in the Braun shops at Alhambra. These pieces, over 25 feet in diameter, were hauled 20 miles to the refinery. The excessive clearances required heavy, low bed trailers and movement during the night to avoid traffic tie-ups.

The special alloy material called for carefully controlled welding techniques. The parent metal adjacent to the welds had to be held under uniform preheat throughout the welding procedure. All root-welds were proved up by magnetic particle inspection before succeeding welds were made. Every foot of welding was radiographed 100 percent. The shop welds were X-rayed, and the field welds were gamma-rayed with radioactive cobalt.

At the refinery, two large concrete work pads were installed as bases for building the new reactor in two sections. When the sections were completed, cyclones and stripping cells were installed. Then the top half section was lifted onto the bottom half section, and the whole vessel was welded into a complete assembly. This work was started in January and completed in March. Meanwhile the cracker continued on its regular run.

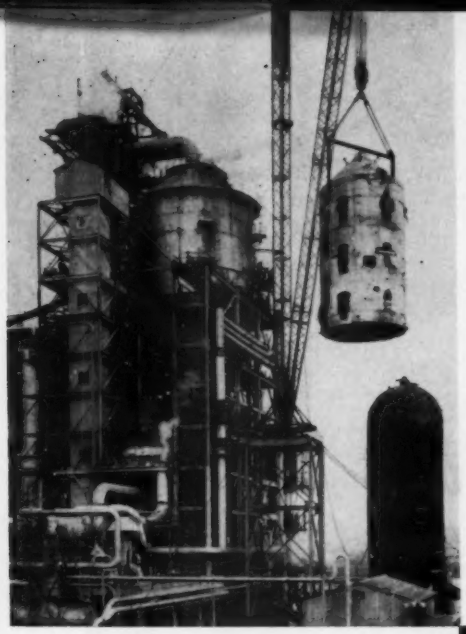
The heavy rigging operation is a story in itself. Low permissible soil-bearing pressure at the refinery required the use of piling to carry a heavy concrete base supporting the derrick structure. The 200-ton guy derrick was mounted on top of a 65-foot steel structure. The main mast extended some 250 feet above grade, or 40 feet above the cat cracker itself.

The derrick boom was 160 feet long. It operated under full load at a radius of some 60 feet. About two miles of 1½ inch high-strength steel cable was used for guy lines from the mast head to ten concrete deadmen embedded 12 feet below grade. The load lines were reeved as 22 parts of one-inch hoisting cable.

The rigging job was a rather delicate operation considering the heavy lifts and the close clearances. Under full load, the top of the mast moved over a foot closer to the loaded boom. This complicated the problem of swinging the reactor over existing equipment and into the structure. The clearances were only a few inches between the reactor and the adjacent steelwork. Careful preparations paid off however when the rigging got under way.

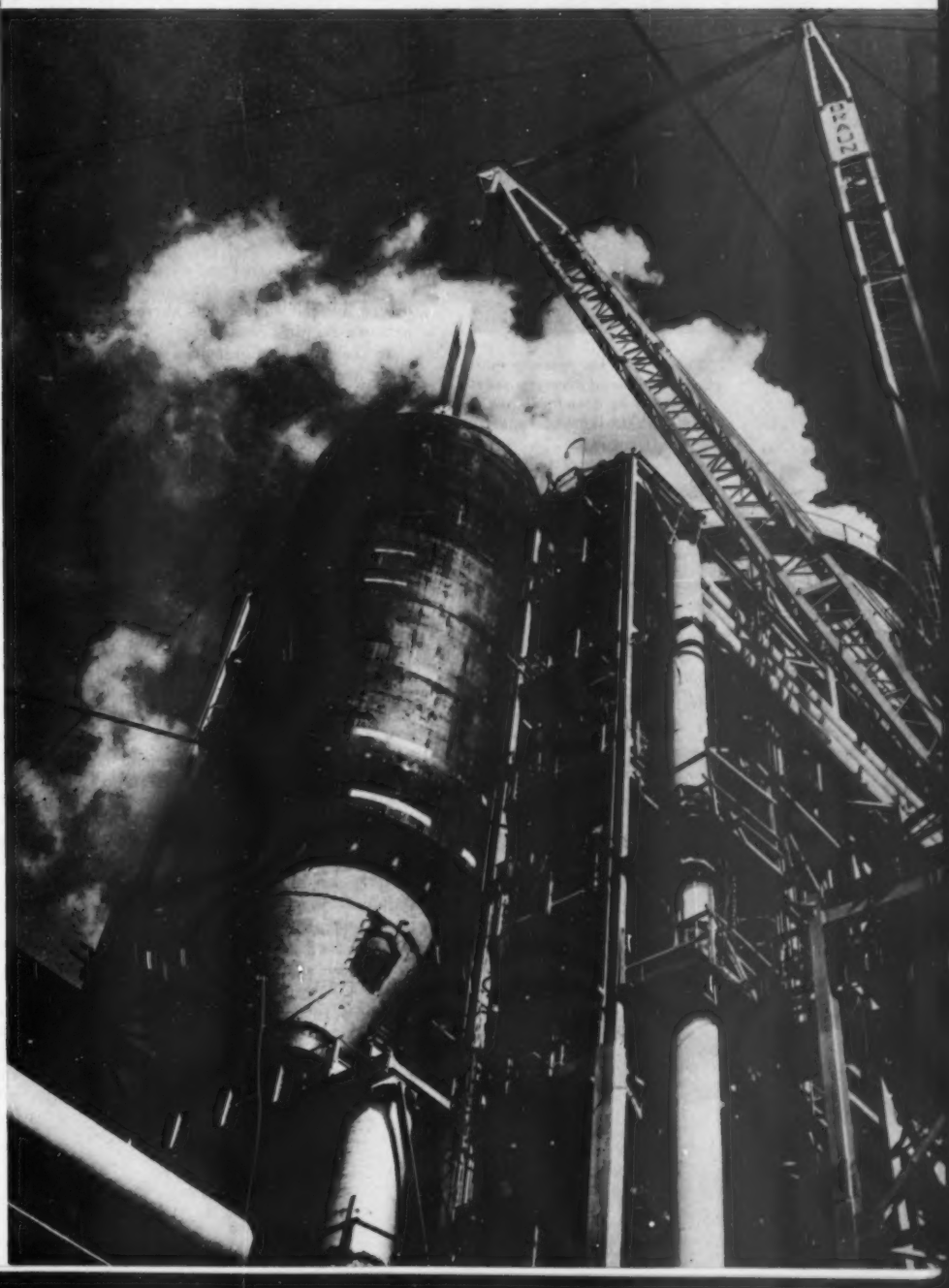
The new reactor was completed on time a week before the scheduled turnaround. On April 7, the fluid unit was shut down. Some 700 tons of catalyst were removed from the system. Part of the cracker structure was stripped away and duct work dismantled. The old reactor was cut into two sections, lifted out, and hauled away. The replacement vessel was raised in one piece, swung over existing equipment, and lowered into the structure.

Each of the heavy lifts was accomplished without mishap and in the matter of a few hours per lift. Most of the down time was devoted to dismantling the structure and ducts, replacing them, applying insulation, and making other repair operations. On May 3, just 28 days after the shutdown, the new reactor was completely hooked up and starting its next regular run, all as had been scheduled nine months before.



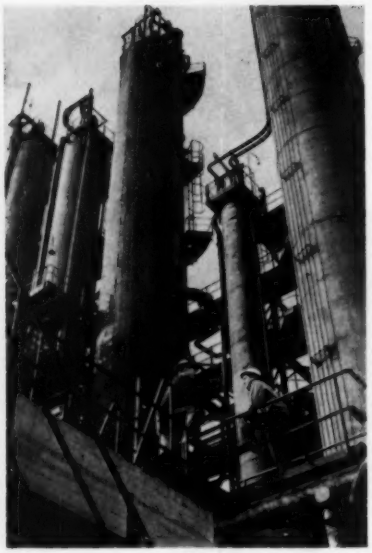
Top section of the old reactor swings clear. Bottom section is still in place in the structure. New reactor is at the right.

Bottom of the old reactor swinging out of its supports with its stripping cylinder, skirt and cone in one piece.



The big lift. The new 194-ton reactor, completely prefabricated with internals in place, is eased into position in the cat structure with bare inches of clearance.

U. S. refiners raise capacity to meet defense requirements



Columns of the recently built benzol recovery plant installed by Standard Oil Co. (Ind.) at its Whiting refinery.

Workmen line up 14-inch steam line expansion loop at the Houston refinery of Shell Oil Co.

FACING THE NECESSITY of a million barrel increase in daily capacity, the refining industry of the United States has entered upon a new program of construction and expansion of plant facilities requiring an investment of upwards of a billion dollars during the coming year. This is in addition to projects previously approved and carried out during the year now ending which involved a like expenditure and added 500,000 barrels to the nation's refining capacity.

In the Atlantic Coast area notable additions are being made in the Philadelphia refining district. These include the enlargement of Gulf's Philadelphia plant by the installation of the world's largest distillation unit with a daily throughput of 125,000 barrels, engineered by Foster-Wheeler, and a 63,000-barrel fluid catalytic cracker of M. W. Kellogg design. Other additions to be completed in 1953 are a catalytic reformer and a gasoline sweetener, each of 10,000 b/d capacity.

Major processing units being constructed for Atlantic Refining Company at its Point Breeze refinery are an Orthoflow catalytic cracking plant of Kellogg design, a catalytic reformer built by the E. B. Badger division of Stone and Webster, a synthetic anhydrous ammonia plant, an alkylation unit, a 50,000-barrel two-stage distillation unit engineered by Foster Wheeler and various auxiliary equipment. The Orthoflow unit will have a rated daily throughput of 33,000 barrels of fresh feed, plus 17,000 barrels of recycle charge, doubling the refinery's catalytic cracking capacity. The sulfuric acid alkylation unit will produce 3,500 b/d of alkylate for high octane aviation and motor fuel blending. The ammonia plant, to be constructed by Hydrocarbon Research, Inc., will incorporate a new system of utilizing hydrogen gas.

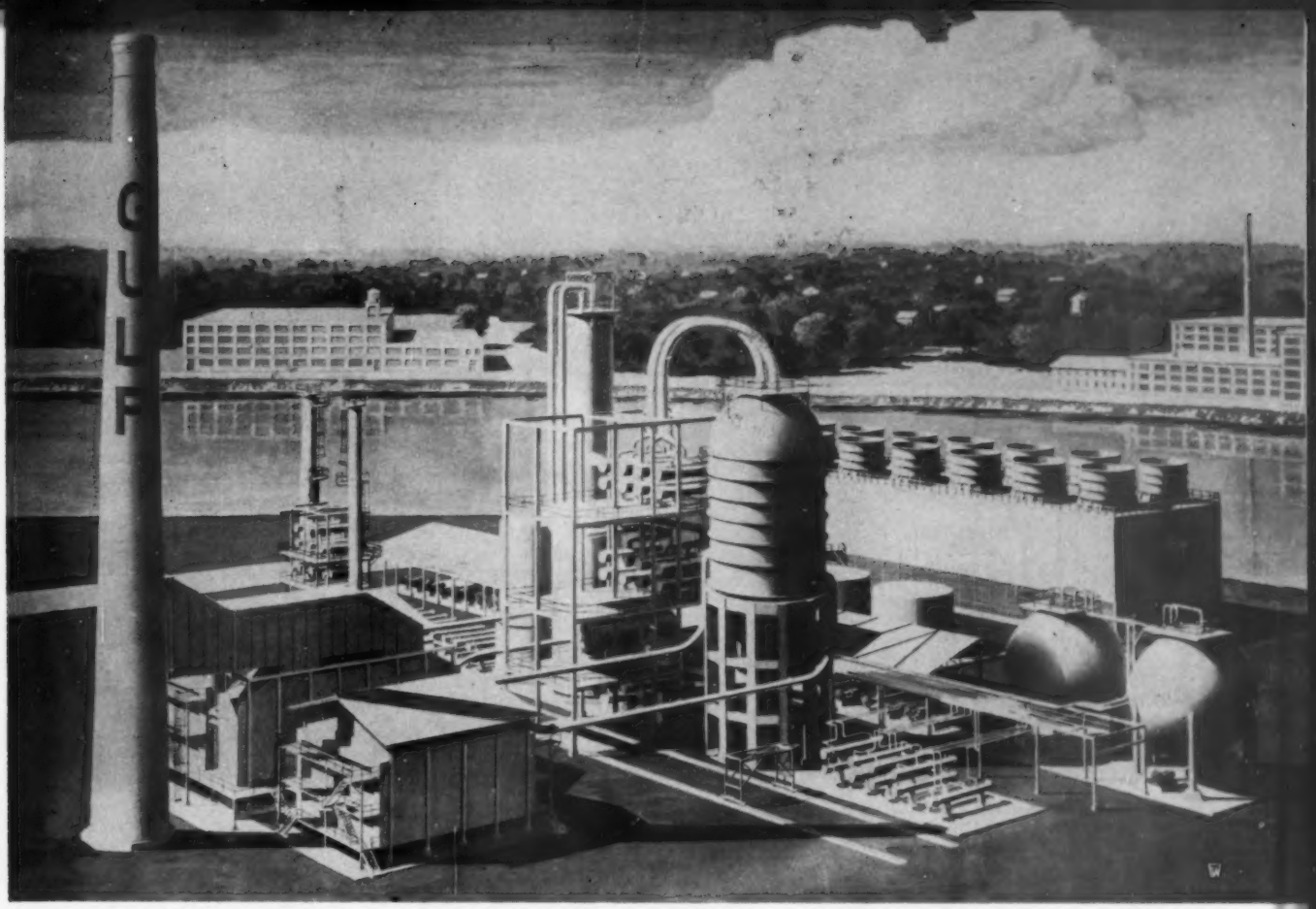
Sun Oil Co. will spend $110 million this year on expansion in addition to $80 million devoted to the same purpose during the past year. Among additions to its big Marcus Hook plant will be a combination crude and vacuum distillation unit for producing 250,000 barrels per month of naphthenic lubricants and a naphthenic acid and sulfonate extraction plant, both of which are to be finished during the current year. For completion in 1953 are a combination catalytic and arosorb plant, enlargement of the present lube oil, catalytic cracking and tetraethyl lead blending units, and additions to the propylene polymerization and gas recovery plants.

For Sinclair Refining Co. a sulfur recovery plant is being built by Ralph M. Parsons Co. at Marcus Hook to produce 21 tons per day, and at Wellsville, N. Y., Sinclair is preparing to install a propane de-asphalting unit.

As an addition to its great refining plant at Westville, N. J., opened last year, The Texas Co. is preparing to install a desalting unit with a capacity of 60,000 b/d for completion next year.

At Brooklyn, N. Y., Socony-Vacuum has added a 15,000-barrel TCC unit to its plant and at Tonawanda, N. Y., Frontier Refining Co. is increasing crude oil capacity by 4,000 b/d and reforming capacity by 10,000 b/d. Esso Standard is enlarging its Everett, Mass. refinery by installation of a fluid catalytic cracking unit of 18,500 b/d capacity, a 7,000-barrel rerun pipe still, a gas compression plant, light ends unit and alterations of equipment. At Bayonne, N. J., the Lummus Co. is building for Esso Standard a 28,500-barrel atmospheric unit and at Baltimore, Esso is installing a 60,000-barrel desalter built by M. W. Kellogg Co.

Ashland Oil and Refining Co. is introducing extensive improvements at its Tonawanda, N. Y., and Cattlettsburg, Ky. plants. These involve a revamping of processing equipment and addition of a catalytic polymerization unit and a kerosine treating plant at Tonawanda and



Artist's drawing of the 125,000 b/d distillation unit being erected by Foster-Wheeler at the Philadelphia refinery of Gulf Oil Co.

an 11,000 b/d vacuum unit and crude tower that will increase cracking capacity by 5,000 b/d. Catalytic Construction Co. is the general contractor.

At Cleveland, Ohio, Standard Oil Company of Ohio is completing the 50,000-barrel crude unit constructed by Arthur G. McKee Co. which was begun last year and at its Toledo plant is preparing to add an alkylation unit of 3,000 b/d to be finished next year. At Lima, Ohio the same company is enlarging its facilities by raising its catalytic cracking capacity to 27,000 b/d and will install a catalytic reformer of 15,000 barrels and a coking unit of 30,000 barrels, both to be built by The Lummus Co.

Sun Oil Co. has made appropriation for a catalytic naphtha reformer of 11,000-barrel capacity at its Toledo, Ohio refinery and for a large addition to its propylene polymerization unit at the same plant, together with additional storage and auxiliary equipment. Both projects are in the design and procurement stage.

Pure Oil Company's Toledo refinery is to be expanded by addition of a vacuum feed preparation unit which, with the existing delayed coking unit, will provide feed for a new Orthoflow cracking unit designed by M. W. Kellogg Co. with a capacity of over 15,000 b/d of total feedstock. A new catalytic polymerization unit will process propylenes to improve the quality and yield of motor gasoline. Alkylation feedstock will be processed to produce alkylate for blending to military aviation gasolines. The new treating facilities will be incorporated into an existing crude distillation unit. Additional boiler capacity, a new water cooling tower, air compression facilities, expansion of the electrical distribution system and enlargement of storage will be parts of the program which is scheduled for completion in 1953.

Following construction of its 40,000 b/d modern refinery at Robinson, Ill., completed last year, Ohio Oil Co. is enlarging its catalytic cracking capacity to 18,000 barrels and is now preparing to add a coking unit of 5,000 b/d capacity to be built by The Lummus Co., together with a 7,000-barrel catalytic reformer and an alkylation unit producing 1,500 b/d. The Texas Co. is preparing to enlarge its Lockport, Ill. plant by addition of several new installations, including atmospheric vacuum, furfural refining, solvent dewaxing, propane de-asphalting, and percolation filter units and a contact filter plant. Completion of the program will extend into 1954.

At East Chicago, Cities Service Co. is extending the facilities of its refinery and at Cicero, Ill., it recently opened a grease plant designed to produce 8,375,000 pounds annually. At Calumet City, Ill., Wood River Oil and Refining Co. is erecting a new refinery of 15,000-barrel capacity with a cracking throughput of 6,500 barrels.

Sinclair Refining Co. has added to its East Chicago plant a 20,000-barrel vacuum still installed by Arthur G. McKee & Co., and at Wood River, Ill., is installing a sulfur dioxide treater of 10,000 b/d capacity, engineered by Stone & Webster.

As part of the Shell Oil Company's program for enlarging its refining facilities by 25 percent or 100,000 b/d, a thorough revision of the company's historic plant at Wood River, Ill. will take place, raising its daily capacity to 50,000 barrels. Another phase of the program will bring about the addition of a catalytic cracker at the Norco, La refinery and an increase in its throughput to 25,000 b/d.

Standard Oil Co. (Ind.) has undertaken a program of expansion for the current year which will involve capital outlays of $200 million or more and will include new refinery construction and enlargement of practically all its existing plants. At Whiting, Ind., additions include a benzene plant which is to have a capacity of 16,000,000 gallons per year and a unit for the recovery of 55 tons daily of elemental sulfur, the latter being constructed by the

Ethyl chloride synthesis unit at Ethyl Corporation's new $40 million petrochemical plant at Houston, Texas. C. F. Braun & Co. photo.

Fluor Corp. Both of these are scheduled for completion before the end of 1952.

At its Wood River refinery, Standard is installing a plant to produce iso-octyl alcohol at the rate of ten million pounds per year. Wood River also will see an enlargement of its facilities for production of an improved detergent additive used in compounding heavy duty motor oil. Processing capacity of the Sugar Creek, Mo., refinery is being raised from 38,000 to 68,000 b/d. A catalytic cracker and an alkylation unit are being added to the refinery at Neodesha, Ka. In addition to the enlargement of its existing plants, the company has announced its intention of erecting a refinery of 15,000 b/d initial capacity at Mandan, N. Dak. to process Williston Basin crude. The plant will be designed with a view toward later expansion as production and market demand in the area increase.

Several Michigan refineries are expanding facilities to meet new and growing requirements. Dow Chemical Co. is preparing to erect a toluene plant at Midland. Leonard Refineries, Inc., at Alma, is enlarging crude oil capacity by 10,000 b/d, besides adding to its catalytic cracking equipment and increasing its asphalt and LPG equipment. Old Dutch Refining Co. at Muskegon is adding 7,500 b/d to its running capacity and installing a 1,200-barrel Platformer under direction of Universal Oil Products Co. At Mount Pleasant, Procon, Inc., is installing for Roosevelt Oil and Refining Co. a UOP Platforming unit of 1,800-barrel capacity.

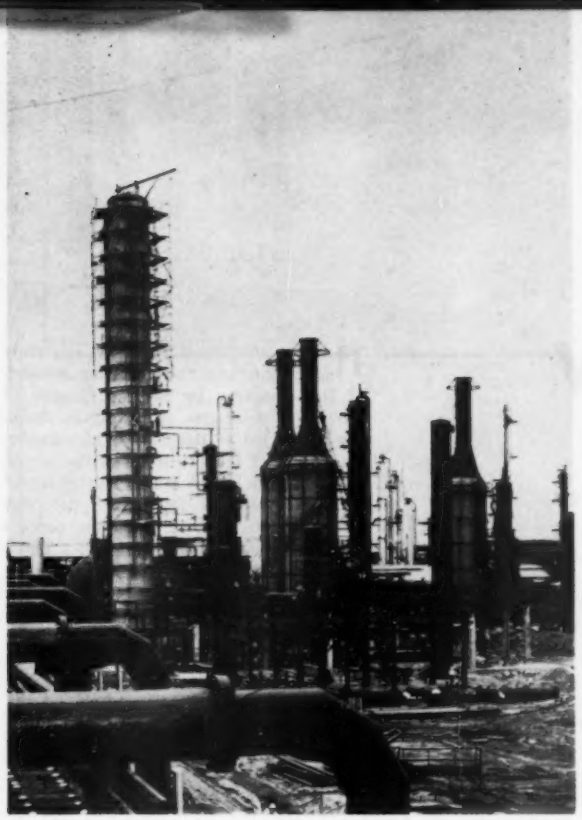
In Minnesota the second refinery projected to operate on Canadian crude is being built at Wrenshall for International Refineries, Inc., by The Lummus Co., and at St. Paul Park a 7,500-barrel catalytic cracker of UOP design is being installed for Northwestern Refining Co. by Procon.

Great Northern Oil Co. at St. Paul is installing a 30,000 b/d crude unit, a catalytic cracker, an alkylation unit, a catalytic reformer and a polymerization unit.

Capacity of Kansas refineries will be increased by numerous new installations. At Phillipsburg the Cooperative Refinery Association is preparing to enlarge its crude and cracking facilities by 4,000 b/d during 1953 and to install polymerization and gas concentration units. The National Cooperative Refinery Association is adding a 10,000 b/d catalytic unit to its McPherson plant together with a catalytic polymerization unit and an enlarged crude unit. Vacuum and thermal cracking equipment is being revamped, the whole operation being in charge of Refinery Engineering Co. The same firm is directing the 6,000 b/d capacity of Eldorado Refining Company's refinery and the installation of vacuum and catalytic cracking units for Kanotex Refining Co. at Arkansas City. Southwestern Engineering Co. is in charge of the 4,000 b/d enlargement and catalytic cracking unit of Vickers Petroleum Co. at Potwin planned for 1953. This installation embodies the "package type" TCC unit developed and licensed by Socony-Vacuum Oil Co.

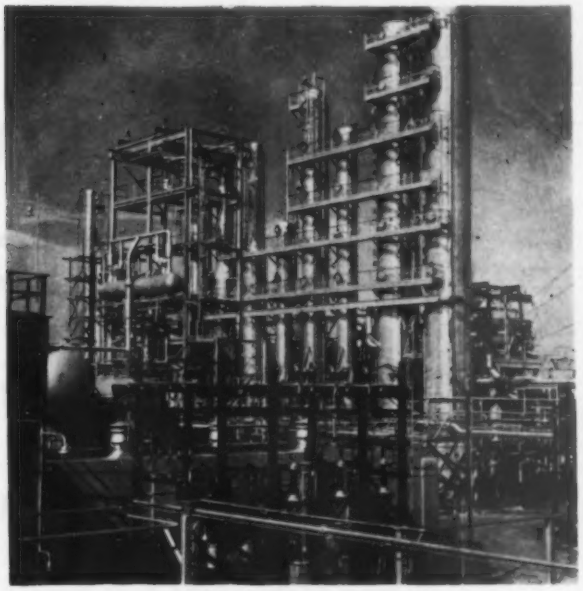
At Memphis, Tenn., Koch Engineering Co. is installing for Delta Refining Co. a 2,000 b/d crude unit and a catalytic cracker of 3,000 barrels capacity. Further south, in Louisiana, a broad expansion of refining facilities is under way. In addition to the enlargement of Shell's Norco plant previously mentioned, Esso Standard is preparing to add a crude still of 60,000 b/d at its big Baton Rouge refinery during the coming year, along with an enlargement of its cracking and other facilities. The project is engineered by M. W. Kellogg Co. Pan-Am Southern Corp., a member of the Indiana Standard group, is installing the world's first fluid hydroformer in its refinery at Destrehan, La. It will have a capacity of 2,000 b/d and will produce a variety of products including the upgrading of low octane naphthas to high octane gasoline. M. W. Kellogg Co. are the engineers in charge. At El Dorado, Ark. the company is installing a second fluid cat cracker of 89,500 b/d and has built a chemical extraction plant.

Continental Oil Co. is spending $24 million to raise the daily throughput of its Lake Charles, La. refinery from 12,000 to 40,000 barrels. Facilities to be added include crude distillation, catalytic cracking, reforming and polymerization units, gas recovery and solvent extraction equipment. The work is being engineered by the E. B. Badger division of Stone and Webster. Cities Service Co. is installing a 5,000 b/d hydroformer at its Lake Charles refinery, and the wax forming unit of the Cit-Con plant, jointly owned



Construction is well under way at Continental Oil Company's Lake Charles, La., refinery where $24 million is being spent on expansion to 40,000 b/d.

Much current refinery work involves equipment to increase aviation gasoline production. Shown below is the alkylation unit at Pure Oil Company's Smith's Bluff, Texas refinery.



by Cities Service and Continental, is being doubled in size. Lion Oil Co. is building a chemical plant at Luling, La. for the production of 300 tons daily of anhydrous ammonia. Lion is expending $5 million on the expansion of its El Dorado, Ark. refinery.

A noteworthy addition to Texas refining facilities will be the paraxylene plant of Humble Oil and Refining Co. which is being installed as an addition to its great Baytown refinery by C. F. Braun Construction Co. The plant is designed to produce upwards of two million pounds of paraxylene per month and is scheduled for completion by mid-1953. The material, produced by a special process developed by Humble, is important to the manufacture of Dacron for which there is a rapidly growing demand from clothing manufacturers. Other additions contemplated for Baytown are substantial enlargements of the de-asphalting and gas recovery facilities.

Humble is engaged also in constructing a research center in Houston which will have as its main building a structure providing 112,000 square feet. It will house the company's geophysical and geologic research sections, the production research division, the petroleum engineering laboratories, and the shops where research equipment is to be made. Plans allow for later enlargement as conditions may require. Behind the main building will be a 30,000 square foot warehouse.

Sinclair has under way an enlargement of its Houston refinery which will raise daily capacity from 85,000 to 110,000 barrels. It includes a 50,000 barrel catalytic cracker complete with fractionator unit and gas plant with construction by C. F. Braun Co.

Expansion activities at Magnolia Petroleum Company's Beaumont refinery during recent months have included a liquid feed installation on the air-lift TCC unit, a connection section on the TCC unit furnace, an electronically controlled loading system for heating oil, and a new furnace for the combination unit. Improvements to be carried out during the coming year include the installation of a feed preparation unit to serve catalytic crackers and replacement of furnaces. Construction of a new Thermofor catalytic reforming unit is to begin within this period.

A three-part enlargement program under way at Pure Oil Company's Smith's Bluff refinery comprises installation of an Orthoflow catalytic cracker, a catalytic polymerization unit, and substantial expansion of alkylation facilities. Associated features of the program include cooling towers, water facilities, steam and electric services, and other utilities. The main additions are engineered by the M. W. Kellogg Co.

Shell Oil Co. is contributing to the national defense program through construction of a new unit at its Houston plant which is scheduled to go on stream before the end of the year and will produce 1,250 b/d of benzene and 2,500 of toluene. Shell Chemical Co. is installing at Houston a sulfur plant and an ethyl chloride unit.

Texas City Refining, Inc. is soon to install the world's largest Houdriflow unit at Texas City. It will have a daily capacity of 19,000 barrels and will be employed to crack heavy stocks into high octane fuels. Completion is expected before the end of the year.

At Port Arthur, The Texas Co. is adding to its steam facilities and increasing its daily crude capacity by 20,000 barrels under the engineering guidance of Foster Wheeler. For 1953, The Texas Co. will increase the capacity of its El Paso refinery by installation of a 4,000-barrel crude unit and a 5,000-barrel cat cracker. At Amarillo construction will include a crude unit of 6,500-barrel capacity, a 5,000-barrel cat cracker and an alkylation plant.

Other Texas installations include additions to Gulf's Port Arthur plant of isooctyl facilities, an ethylene unit being built by The Lummus Co., and a sulfur unit contracted for by Ralph M. Parsons Co.

Cosden Petroleum Corp. is incorporating a UOP Platformer and a UDEX unit being erected by Procon Inc. in its Big Spring refinery. Eastern States Petroleum Co. of Houston has enlarged its cracking equipment, installed a platformer, and is reactivating its alkylation unit. Fulton and Olmstead, of San Antonio, have contracted with Koch Engineering Co. for a new refinery to include a 10,000-barrel crude unit, a 4,650-barrel

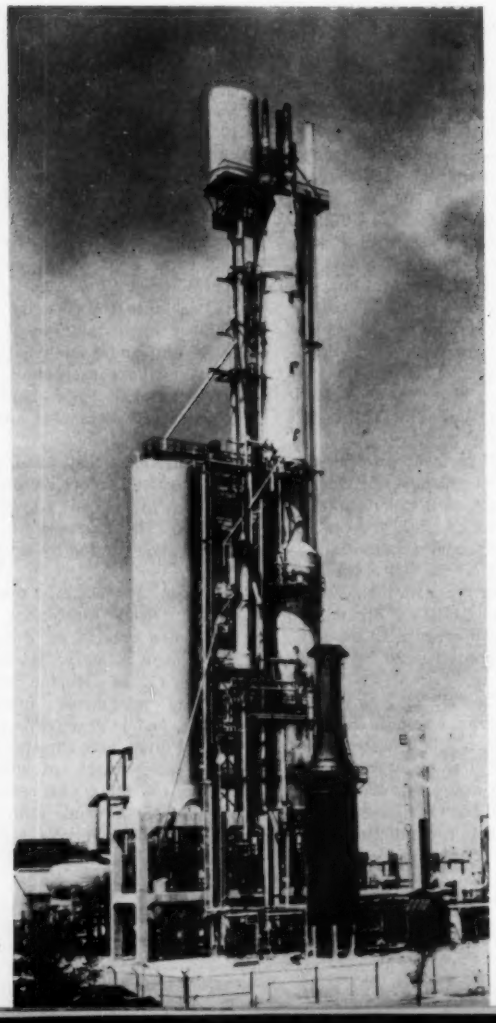
(Please turn to page 142)

HOUDRIFLOW CATALYTIC CRACKING

A PROGRESS REPORT

By D. B. Ardern
Supervisor of Technical Service, Houdry Process Corp.

and A. W. Hoge
Supervisor of Process Design



Eleven thousand barrel Houdriflow unit installed by the Shamrock Oil & Gas Corp., Sunray, Texas.

HOUDRY PROCESS Corporation currently is celebrating the 25th anniversary of the discovery by Eugene Houdry of the basic principles of catalytic cracking which led to the successful commercialization of the process. In the period since the first commercial catalytic cracking unit (Houdry fixed-bed type) was placed in operation in 1936, the process has been modified continuously. There are now in operation ten installations of the Houdriflow type which represent the most recent design. Two more will go on stream this year and two in 1953.

In reviewing the cracking developments in the past quarter century, one is impressed not only by the impact on the petroleum industry of Houdry's pioneering efforts in catalytic cracking, but also by the equally spectacular developments which have revolutionized the art within a relatively short period. The original Houdry catalytic process conceived as a fixed-bed subjected to a cyclic flow of hydrocarbons and regeneration air was superseded during World War II by the moving-bed process, as typified by the Houdry Thermofor Catalytic Cracking process[1] (Figure 1). In essence, a TCC installation consists of a reaction vessel in which cracking occurs, and a separate kiln in which the catalyst is regenerated. Specially designed bucket elevators lift regenerated catalyst from the bottom of the kiln to the top of the reactor and spent catalyst from the bottom of the reactor to the top of the kiln. The catalyst flows by gravity through the kiln and reactor vessels. The moving-bed Thermofor process employing the basic principles of Houdry overcame many of the limitations encountered in the original fixed-bed process. Notably, investment costs were markedly reduced (particularly for sour stocks), and operating complexities were simplified.

The Houdriflow process, announced to the petroleum industry by Houdry Process Corp. in 1948, is, in turn, an outgrowth of the TCC process. Retaining the inherent moving-bed advantages of its forerunner, Houdriflow (Figure 2) incorporates many major improvements in moving-bed technique. The reactor and kiln are superimposed in a single structure. This arrangement makes it necessary to lift the catalyst only once.

[1] Developed through the unified efforts of Houdry Process Corp., Sun Oil Co., and the Socony-Vacuum Oil Co.

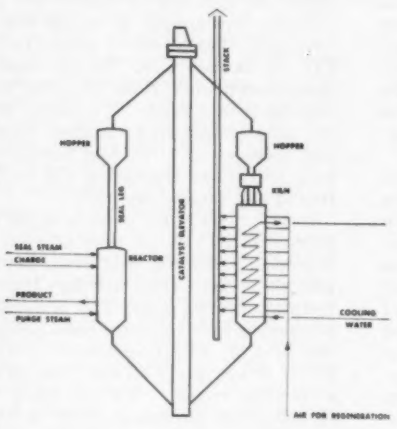


Fig. 1. Flow scheme of TCC process at time of World War II.

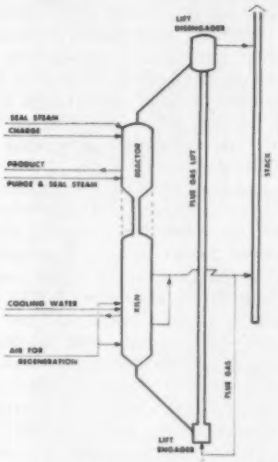


Fig. 2. Original Houdriflow process as announced in 1948.

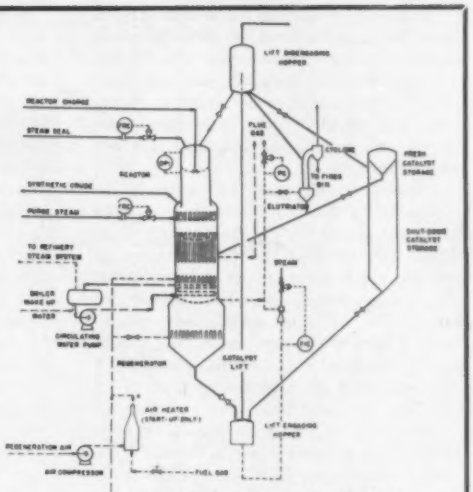


Fig. 3. Flow diagram of modified Houdriflow process as built today.

Another significant innovation is the gas lift for catalyst which replaces mechanical elevators. By removing limitations on catalyst circulation rates, the gas lift has made possible operations in any desired range of catalyst-to-oil ratios, and enables refiners to charge liquid feed stocks directly to the reactor without vaporization. Thus high catalyst circulation rates have decreased feed preheat requirements, improved the heat balance between reactor and kiln and increased the utilization of oxygen in regeneration. Flexibility thus is afforded in the choice of operating conditions and type of charging stocks processed.

Of the many mechanical simplifications which have been incorporated, most striking is the kiln design. With the higher circulation rates, a much greater part of the heat of regeneration is absorbed by the catalyst without reaching deactivating temperatures. Therefore, cooling capacity in the kiln has been materially reduced, and the number of burning zones reduced to not more than three compared to as many as ten commonly used in the Thermofor kiln.

More recently, a modified design integrates the reactor and kiln in a single vessel as shown in Figure 3. Pelleted clay or spherical bead catalyst flows by gravity from the lift disengager to the top head of the reactor. Normally, 50 to 80 percent of the catalyst enters the reactor by way of a falling annular curtain, while the balance feeds through peripheral downcomers which establish bed depth. Liquid or mixed phase feed is introduced through a simplified nozzle located centrally within the curtain of catalyst at the top of the reactor. This nozzle can spray a wide range of liquid-vapor mixtures onto the curtain of falling catalyst. Cracking is completed as the hydrocarbon vapors flow downward through the solid bed reaction zone. Cracked oil vapors are separated from the catalyst in passing through the disengaging and steam purge sections. Efficient purging of spent catalyst contributes to maximum liquid recovery from all stocks.

Spent catalyst enters the kiln, which operates at low pressures, where regeneration is accomplished with air supplied by a single stage blower. Heat is furnished by one, two or three countercurrent burning zones separated by cooling coils. Houdry identifies this layer of hairpin coils as the "pancake" coil design. Water circulates through the coils at a high ratio compared to steam production, thereby providing effective control and maintenance of uniform catalyst temperatures.

Regenerated catalyst emerging from the kiln flows compactly to lift engager vessels where it is elevated by a compressed steam-flue gas mixture to the combination disengager-surge hopper where the cycle is renewed. Catalyst circulation rate is controlled directly by lift operating conditions.

Kilns and reactors have been designed to assure that flow of catalyst, oil vapors in the reactor, and air in the kiln are constant and uniform over the entire cross-section of each catalyst bed. Uniformity in contact time assures optimum operating conditions and yield. The quantity of catalyst deposit is essentially uniform on all catalyst particles. This facilitates regeneration control so that only catalyst regenerated to a consistently low residual carbon level is returned to the reactor.

With two full years of operating experience and a total of ten units on stream, a considerable backlog of operational information is now available.

Plant operators have been pleased by the ease with which units are cut on and off stream without disturbing catalyst circulation and kiln operations. Interruptions such as power outages and mechanical failures do not cause extended lost time after the difficulty is corrected. If the difficulty which forces the cracker to bypass can be corrected in a short time, the Houdriflow is back on stream at full charge rate within a few minutes.

Stable mechanical performance is illustrated in the operation of the Petco Corp. unit. Located in a relatively small refinery at Blue Island, Ill., this Houdriflow has been called upon to operate through two severe winters and numerous interruptions in utility supply. For example, flow and pressure controllers normally are required to govern the operations of the flue gas lift, but during the

past winter the Petco Houdriflow frequently has operated with both of these instruments out of service because the "winterizing" was inadequate for the abnormal conditions experienced. Complete manual operation of the lift system was practical without appreciable additional attention from the operators.

Maintenance costs on units thus far has been low and indications point to minimum servicing requirements. Sun Oil Co. recently brought down one unit for complete inspection after 18 months' operation, and found it to be in excellent condition and capable of indefinite further on-stream time.

Flexibility of operation extends to stocks to be processed. Sweet and sour charging stocks are handled equally well. Even frequent and sudden variations in charge stock have given no problems. The charge stocks have been all virgin, all recycle, and any proportions of the two. Reactor charge may be vapor, liquid, or mixed vapor-liquid. Units have operated with as high as 90 percent of the feed in liquid phase.

A variety of catalysts, including synthetic silica alumina beads, pelleted Filtrol natural clay, and Filtrol's newer SR (sulfur resistant) clay pelleted catalyst are used. Data on catalyst economy in operating units are given in Table I. None of these units has had to withdraw catalyst to maintain activity during normal operations.

Typical yield data from operating plants are compiled in Table II. In some units cracking conversions up to 90 percent are being achieved using recycle/fresh feed ratios of 1/1 or slightly more, while elsewhere once-through cracking is preferred with 50-60 percent conversion.

First Houdriflow units to go into operation were those at the Toledo refinery of the Sun Oil Co., which were placed on stream in the spring of 1950. A unique feature of this installation is the arrangement of four Houdriflow units within a single structure. Each unit was designed to process atmospheric and vacuum gas oils with or without recycling at a total charge rate of 7,000 BPSD and 3,250 lbs./hr. of coke when operating on clay catalyst. Actual charge rates have exceeded the design value.

Sun had specific objectives to achieve in utilizing four smaller Houdriflows in place of one or two large units to obtain the desired 28,000 BPSD. The smaller size permitted the design of all vessels to be limited to a maximum of 12½ feet in diameter, so that kilns, reactors, and lift equipment could be shop fabricated and shipped to the site for erection as finished vessels. The use of four separate units provides maximum flexibility in plant operations. Shutdowns for routine inspection and maintenance can be made on individual units with only slight loss in gasoline yield as recycle stock is backed out of the total charge. In addition, minimum tankage is needed for charge and finished products, and maintenance manpower requirements are reduced.

Over-all centralized control of the cracking units at the Toledo plant is achieved by a graphic panel which has helped to make possible the operation of four units with little additional manpower over that required for one or two large units.

The Houdriflow units at Toledo are of the original design using a reactor separated from a kiln by a seal leg. Regeneration is conducted at sufficient pressure to effect a pressure balance between reactor and kiln, and to furnish flue gas from the kiln directly to the lift system. Originally, Toledo had a single 19-inch I.D. lift on each unit. On the basis of experimental work, these lift pipes were replaced with multiple lift systems. With the latter modification, catalyst makeup now averages 1.5 to 2.0 tons per day for each unit when circulating 220 to 250 tons of clay catalyst per hour.

In 1950, Tide Water Associated Oil Co. dismantled its natural gasoline plant at Drumright, Okla. to make room for the Houdriflow unit which now has been in operation for two years. This Houdriflow was designed for a nominal reactor charge rate of 6,750 BPSD, consisting of 4,500 BPSD of virgin gas oil and 2,250 BPSD of internal recycle. The kiln has a designed carbon burning capacity of 3,600 lb./hr. Although the original plan was to process gas oils from Oklahoma or sour Slaughter-Dugan crudes, most of the stock processed to date has been vacuum gas oil produced from Scurry County crude. A typical inspection of the fresh gas oil is given in Table III.

As in all Houdriflow units, the Gagetron is used at Drumright to determine the catalyst level in the upper lift hopper. This instrument consists essentially of several gamma ray sources (radium salts) inside the vessel and a Geiger counter outside. Variations in the catalyst level change the intensity of rays received by the counter, and these changes are transmitted to the control panel where they are translated into catalyst level readings.

A modified Houdriflow design was introduced at the Salt Lake Refining Company's plant at Salt Lake City, Utah. Oil was first introduced into the reactor of the Salt Lake unit in December, 1950. The performance of this plant was of special importance, because it was the first of a number of Houdriflow installations of modified design in which the

TABLE I

OPERATIONAL DATA FOR HOUDRIFLOW CATALYSTS

Unit	Total Oil Charge Bbls/Day	Type of Catalyst	Catalyst Circulation Tons/Hr.	Catalyst Make-up Tons/Day
Petco, Blue Island, Ill.	5,000	Clay	160	1.5
Sun, Toledo, Ohio (1)	7,400	Clay	240	2.0
Shamrock, Sunray, Texas	11,000	Clay	340	4.0
Tide Water, Drumright, Okla. (2)	6,750	Bead	225	2.5
Salt Lake Refining, Salt Lake City, Utah	14,500	Bead	325	2.5
California Refining, Perth Amboy, N. J. (1)	15,000	Bead	425	4.0

(1) Data for a single unit. Total of four units at Toledo, two at Perth Amboy.
(2) Catalyst make-up for a single lift pipe. Tide Water has just installed a new multiple lift system. Early operation shows a make-up of 1.4 tons per day.

TABLE II

TYPICAL HOUDRIFLOW YIELDS

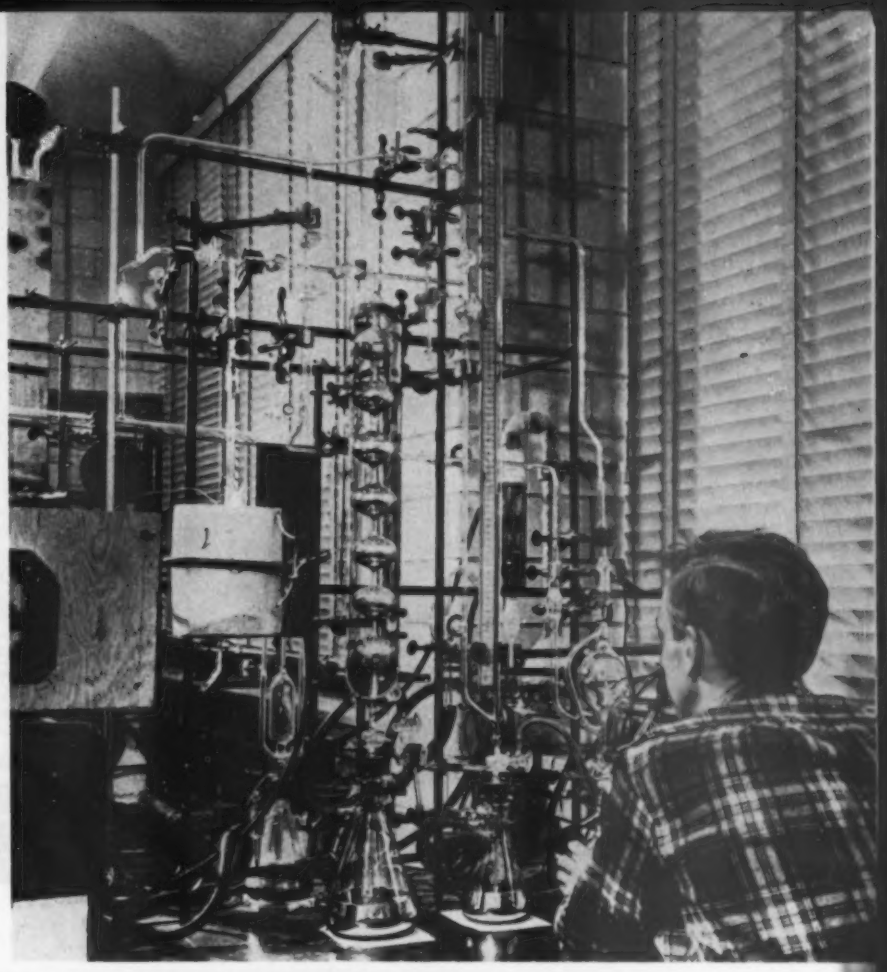
Plant Charge		Sun	Tide Water	Salt Lake	Shamrock
Fresh Gas Oil	BPSD	3,790	4,460	10,165	4,750
Cat. Cycle Oil	BPSD	1,060			
Internal Recycle	BPSD	2,280	2,200	2,520	5,700
Total Reactor Chg.	BPSD	7,130	6,660	12,685	10,450
Yields					
(Fresh Chg. Basis)					
Dry Gas	Wt. %	7.5	5.8	6.1	5.4
C_3 Fraction	Vol. %				13.1
C_3 - C_4 Fraction	Vol. %		20.1		
C_4 Fraction	Vol. %	13.3		14.9	19.0
Gasoline	Vol. %	46.2	52.2	45.4	64.2
Light Cycle Oil	Vol. %	37.8*	19.8	20.3	2.2
Heavy Cycle Oil	Vol. %		11.3	20.0	7.0
Coke	Wt. %	5.2	5.4	2.8	9.0
Conversion	Vol. %	62.2	68.9	59.7	90.8
Liquid Recovery	Vol. %	97.3	103.4	100.6	106.4

* Combined light and heavy cycle oil.

TABLE III

TIDE WATER, DRUMRIGHT HOUDRIFLOW FRESH CHARGE STOCK INSPECTION

°API	28.6
Vacuum Distillation	°F
IBP	375
5%	558
10%	600
50%	755
70%	845
90%	892
E.P.	995
Recovery	95.0%
Conradson Carbon Wt. %	0.26
Sulfur, Wt. %	0.40
Aniline Point, °F	188
Pour Point, °F	85



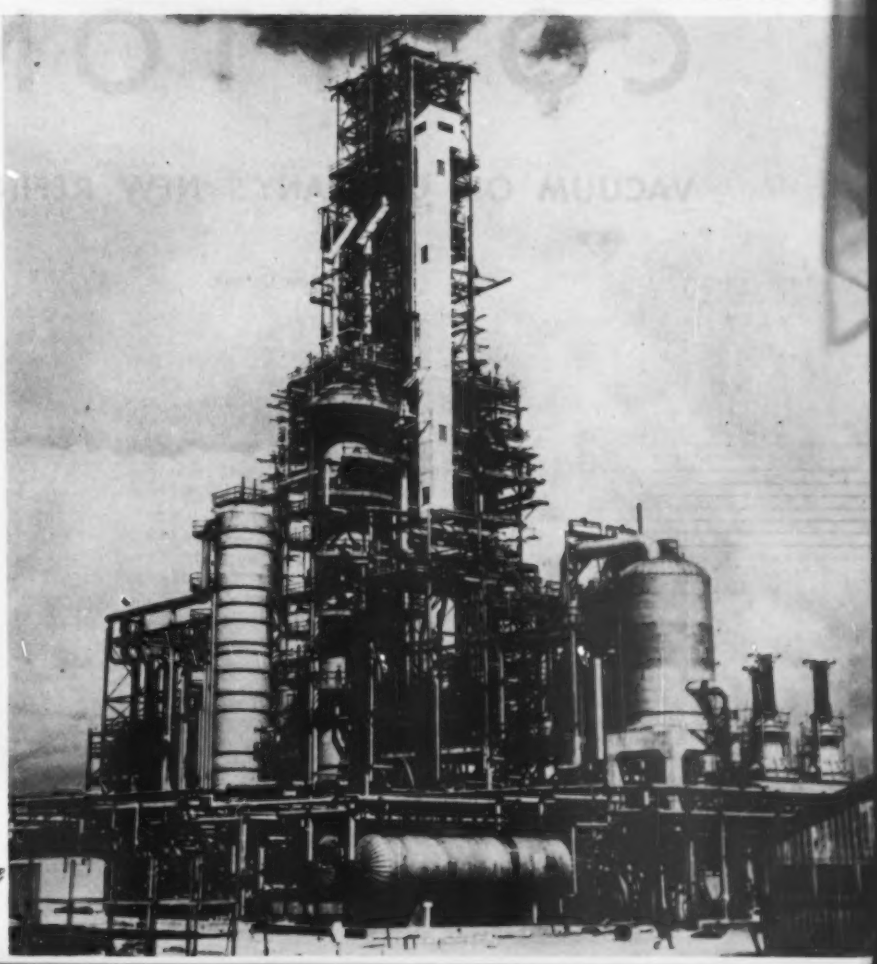
Apparatus for determining surface areas of catalysts for correlation with catalytic activity.

reactor and kiln sections are "unitized" in a single, self-supporting vessel. Oil vapors are confined to the reactor and air and flue gas are confined in the kiln simply through the utilization of a number of short seal pipes arranged in an intermediate tube sheet. While the principle of isolating reaction vessels with a seal leg had been proven by many years of use in a moving bed design, this particular application of the principle was distinctly novel. Four commercial Houdriflow units incorporating this design have been in continuous operation for a year and a half with no evidence of inadequacy of this simple seal system.

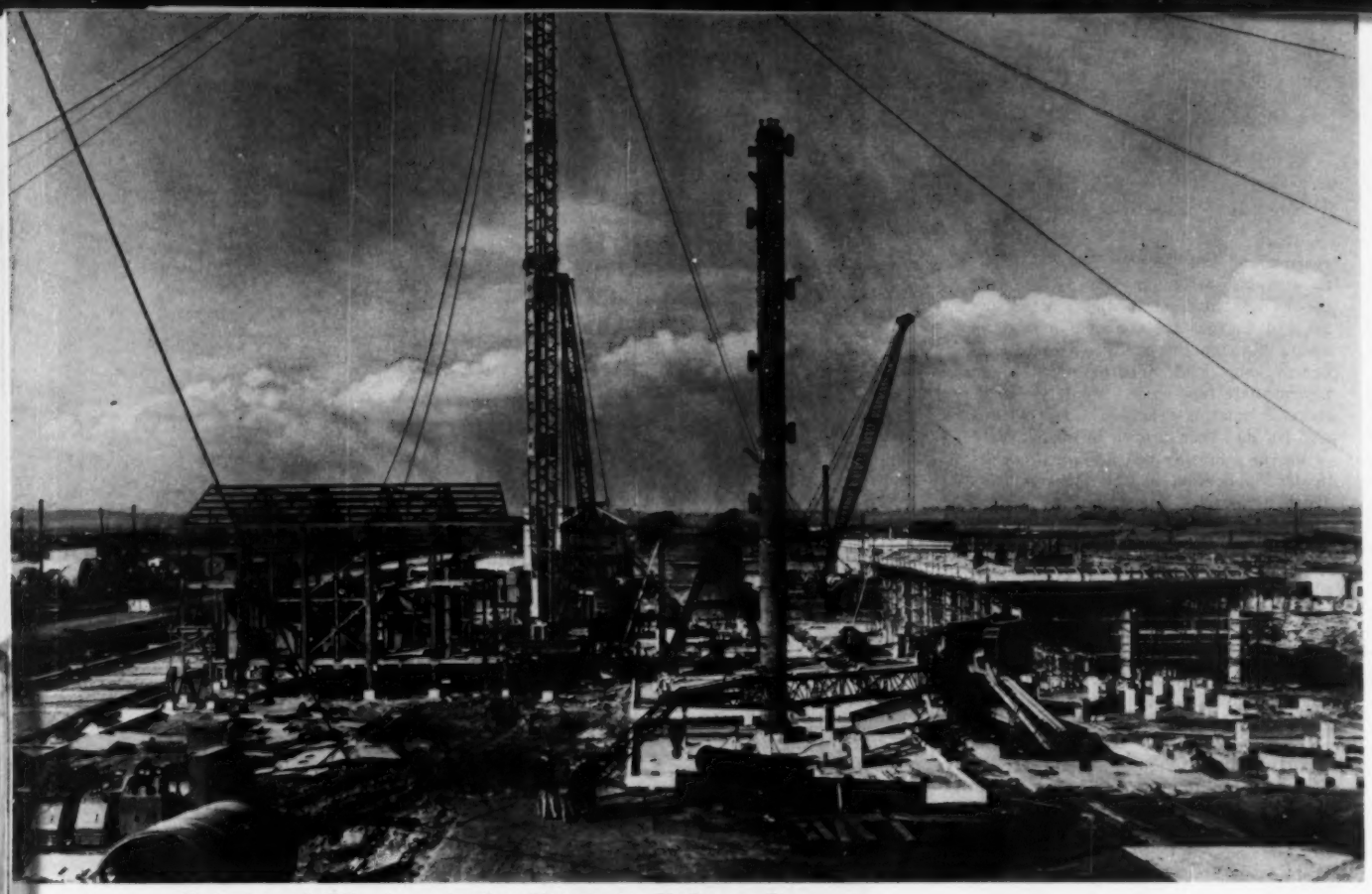
The Salt Lake unit was designed for a nominal fresh charge rate of 10,000 BPSD of vacuum gas oils derived from Rangely crude with an additional 3,000 BPSD of internal recycle. The design rate of circulation of bead catalyst, 300 tons per hour, is accomplished in a lift system consisting of three 13-inch diameter lift pipes arranged in a common engager and common disengager vessel. The Salt Lake reactor has a diameter of 13 feet while the kiln has an upper countercurrent burning zone of 16 feet 6 inches in diameter and a lower countercurrent burning zone 19 feet 6 inches in diameter. The nominal carbon burning capacity is 6,000 lb./hr.

Although it was designed for a total reactor charge rate of 13,000 BPSD, the Salt Lake plant has throughout most of its history handled charge rates in excess of that figure. Similarly, the catalyst circulation rate has varied from less than 300 tons per hour to as much as 360 tons per hour as processing requirements dictated. Furthermore, studies have recently been undertaken jointly by the Salt Lake Refining Co. and Houdry to determine the alterations that would be required to increase the processing capacity of the installation to 16,000 BPSD. The preliminary survey indicated that the alterations required in the catalytic section to achieve this goal would be minor. It probably will be necessary to increase the heater capacity in the feed preparation section and increase compressor capacity in the gas recovery section.

After a run of about nine months' duration, the unit was taken off stream in September, 1951 for a scheduled turnaround and inspection. The metal inspection indicated indefinite life for practically all of the equipment of the catalytic section. A small area of erosion at the lower extremities of the three lift pipes was built up with weld metal. No



Four complete and separate Houdriflow units are assembled within this single structure at Sun Oil Company's Toledo, Ohio, refinery. Aggregate capacity of the four units is 30,000 b/d.



Heater for crude still under construction. Photo courtesy The Lummus Co.

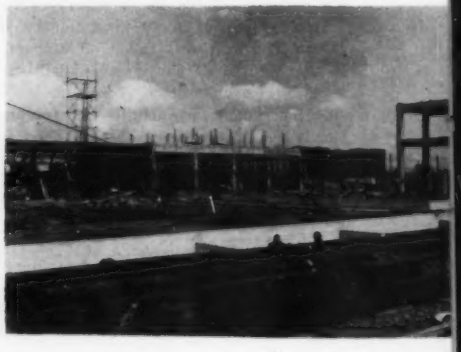
CORYTON:

VACUUM OIL COMPANY'S NEW REFINERY

By E. Lawson Lomax

Crude distillation unit looking southwest.

M.E.K. unit looking south.



A NOTEWORTHY ADDITION to Britain's petroleum processing facilities is the refinery now under construction at Coryton, Essex, on the Thames, which is scheduled for completion early in 1953 with a throughput capacity of 850,000 tons per year or approximately 17,500 b/d.

The land on which the refinery is being built was occupied by Kynoch, Ltd., an explosives company, during World War I, when a large factory for the production of propellants was in operation there. After the war the location was developed for storage and refining purposes by the Cory interests, and it is interesting to note that the first Cross cracking unit to be installed in the United Kingdom was erected on the site. Two jetties were built: one to receive ocean going tankers,

having a depth of 35 ft. of water at low tide; and the other a coastal tanker and barge jetty, together with considerable storage capacity and a small refinery which were operated by the Cory interests until the end of World War II.

Later the site was acquired by the Powell-Duffryn organization. This group and the Socony-Vacuum Oil Co. are joint owners of the Vacuum Oil Co., Ltd. which is erecting the refinery for the production of a full range of lubricating oil together with motor and other fuels.

The total area of land owned by the company is about 1,400 acres, of which about 200 acres are now being developed for the refinery and its necessary storage capacity.

The earlier refinery and its storage tanks imposed relatively light concentrated loads on foundations, and the type of ground available at Coryton, while not of the best for the purpose, proved suitable enough, but for modern refinery equipment much higher loadings of foundations are essential.

As most of the site consists of alluvial mud of considerable thickness, overlying gravel at depths of about 50 feet, and as the general surface of the land is below high water level, a very large amount of site preparation was necessary before building operations could be commenced, which included building of roads, dismantling or re-siting of existing plant, and raising of the general ground level.

Roads were raised to five feet over the original level and the general area of the land was leveled to a surface from one foot to one foot six inches above the existing level. The ground work included filling of fleets or ditches and other depressions while the service area was raised three feet. This preparatory operation required 600,000 cubic yards of filling obtained from local sources and 100,000 cubic yards of cinders.

Piling had to be used for the foundations taking concentrated loads, and for this purpose, 12,000 piles were cast *in situ*, 600 pre-cast reinforced concrete piles were used, while 200 steel piles, in addition to those already in place, were used in improving the jetties. Foundations required 53,000 cubic yards of concrete and 114,000 square yards were laid for roads and yard and area paving. For the roads two layers of BRC fabric were put down in eight inches of concrete. In all, 5,000 tons of BRC fabric and reinforcing rod were used in foundations.

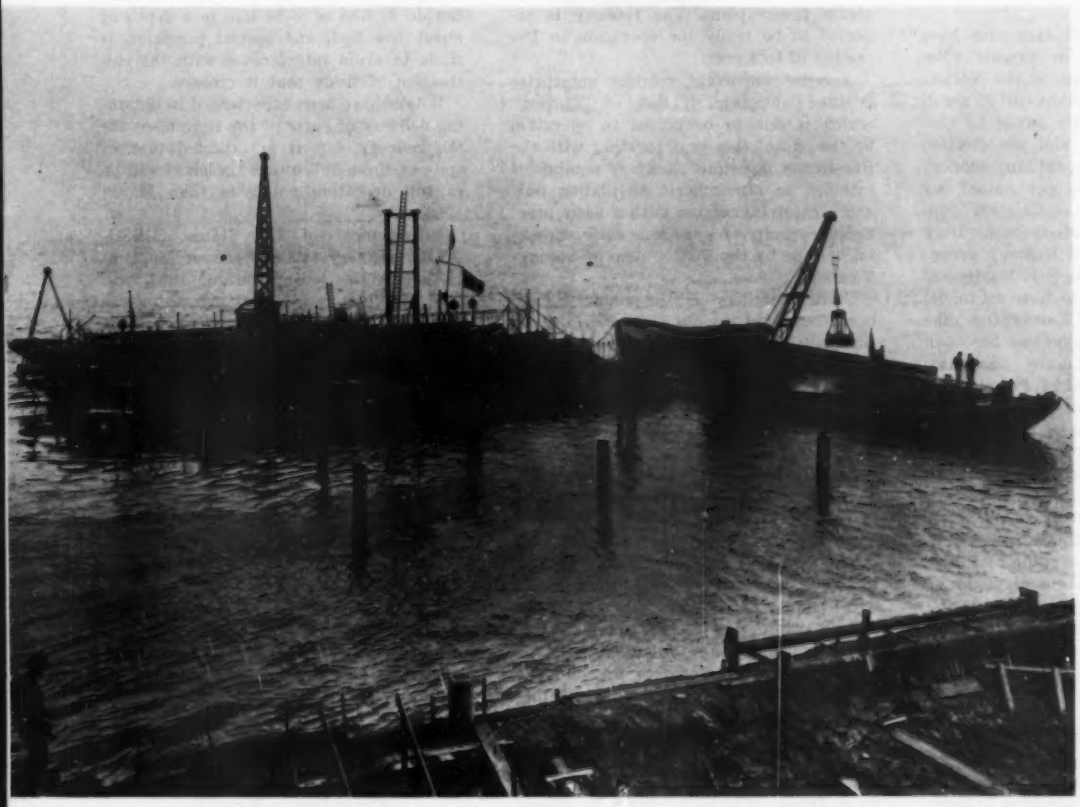
The two jetties already in use on the old installation have been modernized. Two new dolphins have been constructed, 70 feet distant each way from the main jetty, so that modern large tankers can be berthed, giving a total length for jetty and dolphins of 240 feet. In addition, the land approaches to the jetties are being modernized to cope with present and future requirements. The crude oil discharge line is 24 in. in diameter and will enable ship's pumps, supplying their own steam, to discharge at the rate of 2,000 tons per hour.

Riverside works include the provision of a sunken caisson on which will be fitted the pumps for supplying cooling water, taken from the river, for the refinery. This caisson is designed in such a manner that a future jetty can be constructed and tied in with it, if necessary.

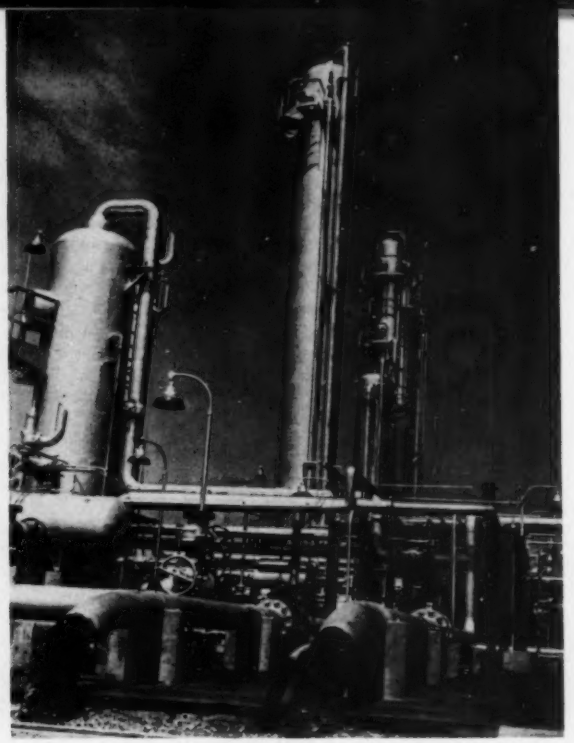
An outfall for clarified cooling water was constructed on Holehaven Creek down river from the site, with the power house cooling water discharging into Shellhaven Creek, up-river from the site, but so far as not to affect the temperature of the intake cooling water to any noticeable extent.

The distillation plant, intended for charging mainly Middle East crude, is a combination atmospheric and vacuum unit of Foster Wheeler design, with a rated capacity of 20,000 barrels per stream day.

(Please turn to page 152)



Water intake jetty weighing 4,200 tons was towed to site and sunk in position in the River Thames. From it 45 million gallons of cooling water will be drawn into the plant each day.



Natural gasoline plant recently put on stream at Cortemaggiore.

ITALY'S REFINERIES

exceed demands for white products, but problem of fuel oil remains

DURING 1951-52 the Italian refining industry has made good progress toward the goal of raising its yearly processing capacity above 10 million tons against the four million tons in operation prewar.

Important steps in the expansion have been the San Martino di Trecate (Novara) refinery belonging to the Societa per Azioni Raffineria Padana Olii Minerali of Turin, which is jointly owned by Caltex and the Fiat Co.; and the erection of the Pantanedo di Rho (Milan) refinery of the "Condor" Societa per Azioni per l'Industria Petrolifera e Chimica controlled by Italian capitalists cooperating with the Manchester Oil Refinery group.

In connection with the San Martino di Trecate plant, which is to have an initial processing capacity of something like 700,000 tons yearly, a pipe line has been laid between Vado Ligure (Savona), where a marine terminal of Petrolcaltex, another Italian subsidiary of Caltex, is located, and San Martino di Trecate. The line has a length of 150 km. (90 miles), and follows the Quazzola river valley, the sides of the Cadibona hills, the Montechiaro hills, the Erro river valley, Alessandria, the Lomellina valley and Mortara. The pipe, encased in a wrapping of Fiberglass and tar enamel, has a diameter of $8^{5}/_{8}$ in. The pipe line capacity is 18,500 b/d and has a single pumping station located in Savona. It is equipped with three horizontal duplex plunger-type pumps driven by electric motors. Each pump has a capacity of 270 barrels per hour, and by addition of a second pumping station, the capacity of the line could be raised to 27,000-37,000 barrels per day. The pipe line is to be formally inaugurated in July.

Along with construction of the pipe line, erection of the San Martino di Trecate refinery has been going forward. The first vacuum distillation unit is in place and waterwells are being sunk to feed the steam power plant. The refinery is expected to be ready for operation in December of this year.

Another important refining enterprise is the Pantanedo di Rho of "Condor" which is due to be placed in operation by the end of this year together with the Rho-Genoa pipe line. Refinery equipment includes an atmospheric distillation unit and a catalytic cracker with a daily processing capacity of 1,400 tons daily. Cracking will be by the TCC system of Socony-Vacuum.

Office buildings of the refinery have been completed, as has the connection of the plant with the road, railway and inland waterways systems serving the Milan district. Of the 61 steel tanks which are to supply storage, 22 have already been placed in position and 39 are in process of erection.

Construction of the electric power plant annexed to the refinery is well advanced as well as that of the fractionating towers and other processing equipment.

The pipe line from Pantanedo di Rho to Genoa, which is to supply the refinery with crude, will have a length of 78 miles from Rho to Genoa Fegino, where the terminal will have a storage capacity of 50,000 barrels connected to the oil dock in the port of Genoa by a double pipe line having a diameter of 16 inches. From Fegino to Rho the pipe line is to have a diameter of 22 inches, and two river crossings are required. The crossing on the river Ticino is to be arranged by means of a suspended bridge of chain structure, while the crossing of the Po is to be on the road bridge already existing between Bressana Bottarone and Cava Manara. The pipe line from Genoa Fegino to Pantanedo di Rho is to be laid to a depth of about five feet, and special provision is made to avoid interference with the cultivation of fields that it crosses.

Delays have been experienced in obtaining delivery of parts of the equipment for the refinery, but it is expected that in spite of these difficulties, the plant will be in full operation not later than March 1953.

Enlargement of the Stanic (ESSO-ANIC) refinery at Leghorn, set for completion in the second half of 1953, will give the plant a crude oil processing capacity of 30,000 barrels per day against the former 12,000. The yearly output of products will include 470,000 tons of gasoline, 47,000 tons of kerosine, 190,000 tons of gas oil, 500,000 tons of fuel oil, 60,000 tons of lubricants, and 10,000 tons of paraffin wax.

Equipment to be installed in the refinery includes a 23,000 b/d vacuum distillation unit, a Duo-Sol lubricating oil plant, propane de-asphalting, and phenol refining equipment.

At Porto Marghera, near Venice, Industria Olii Minerali (IROM) has been carrying forward a program of expansion begun last year. Installation of a new distillation unit at the commencement of 1952 has raised current throughput to 24,700 b/d. Completion of the work under way will increase this to 30,000 b/d in 1953. IROM is a joint enterprise of AGIP and Anglo-Iranian Oil Co.

(Please turn to page 148)

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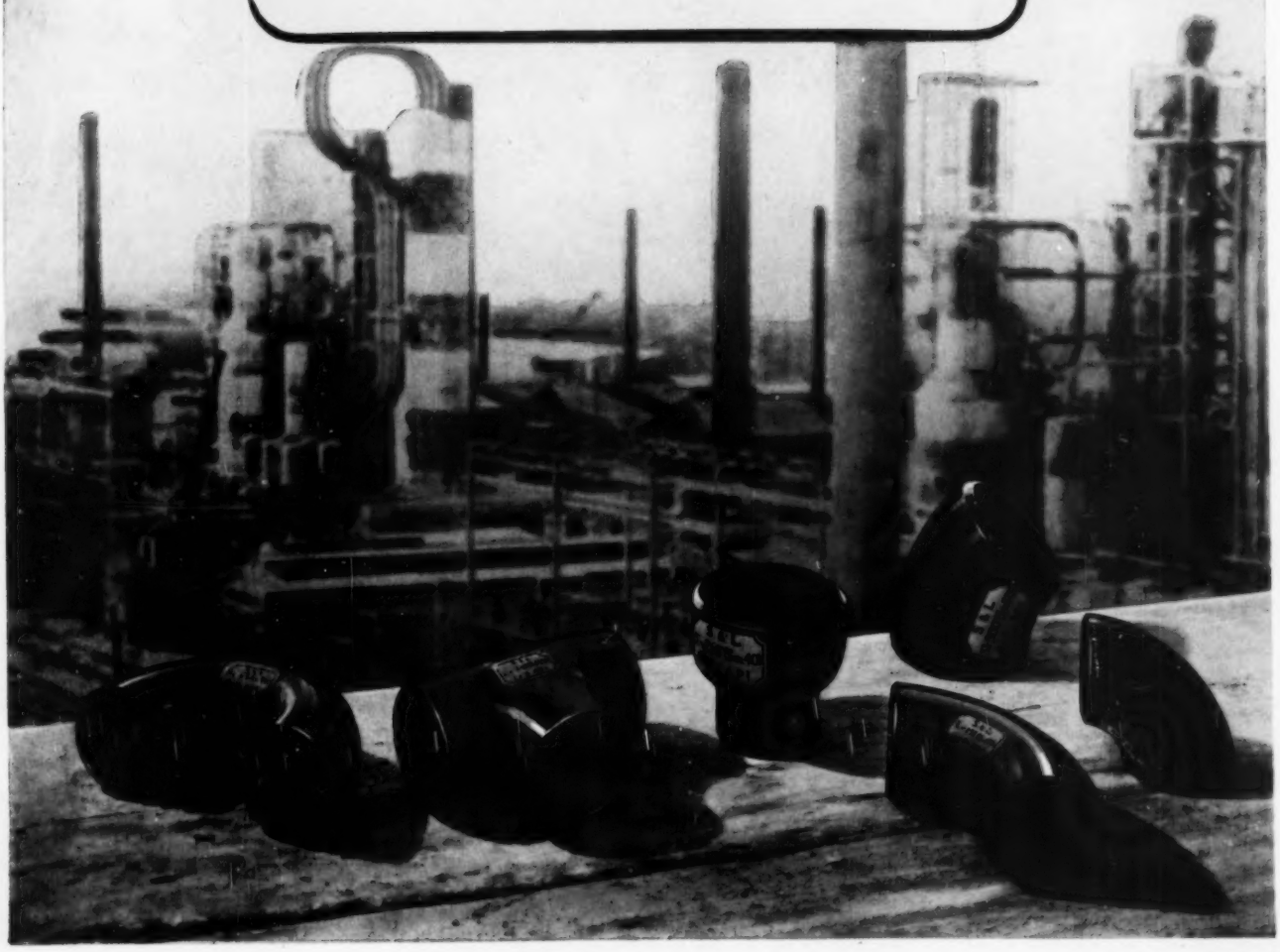


Oil Refineries of the World

The tabulation below has been prepared to show the present capacities and status of oil refineries outside the United States where such information is available. No data is given on U.S.S.R. plants or refineries in nations dominated by the Russians. Capacities are in barrels per day. Key to type of plant: S—Skimming; L—Lubricating; A—Asphalt; C—Cracking; Comp.—Complete. Under cracking capacity to indicate type: T—Thermal; C—Catalytic.

SUMMARY OF REFINERY CAPACITIES

Operating or Operable Capacities, July 1, 1952

Country	No. Plants	Crude Capacity Barrels Daily	Cracking Capacity Barrels Daily
Albania	1	3,000	.....
Argentina	18	174,620	62,520
Australia	5	20,400	1,500
Austria	8	28,050	7,340
Bahrein Island	1	155,000	36,700
Belgium	7	57,000	2,000
Bolivia	4	10,400	.....
Brazil	5	4,750	.....
British Borneo	1	38,500	.....
Burma	3	3,500	.....
Canada	37	442,600	217,700
Chile	3	360	.....
China	1	1,000	.....
Colombia	2	32,900	.....
Cuba	6	7,300	1,100
Denmark	3	775	.....
Ecuador	2	5,700	.....
Egypt	2	47,000	6,400
Eire	1	600	.....
Formosa	1	18,350	4,500
France	15	454,700	26,300
Germany	32	148,170	24,500
Hungary *	4	13,000	.....
India	1	5,500	1,500
Indonesia	6	179,000	41,000
Iran	3	572,100	130,000
Iraq	2	9,500	.....
Israel	1	83,000	33,000
Italy	31	183,000	13,500
Japan	16	92,100	7,000
Kuwait	1	25,000	.....
Lebanon	1	11,000	.....
Mexico	8	229,000	33,000
Netherlands	2	128,000	51,400
Netherlands West Indies	3	630,000	392,970
Norway	1	1,000	.....
Pakistan	1	4,000	1,500
Peru	3	37,500	3,000
Poland *	6	15,000	.....
Portugal	1	7,000	.....
Romania *	20	103,000	33,000
Saudi Arabia	1	160,000	.....
South Africa	1	2,000	2,000
Spain	3	50,300	4,000
Sweden	4	25,900	1,000
Switzerland	2	1,850	.....
Trieste	2	15,830	.....
Trinidad	4	105,000	25,000
Turkey	1	420	.....
United Kingdom	17	512,200	87,000
U. S. S. R.*	25	920,000	300,000
United States	363	7,279,000	4,400,000
Uruguay	1	25,200	2,000
Venezuela	13	326,150	89,000
Yugoslavia	3	11,000	600
Totals	709	13,417,025	6,042,230
Western Hemisphere	459	9,744,790	5,214,390
Eastern Hemisphere	250	3,672,245	827,840

* Estimated.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Albania				
Cerzic	Tirana-Eibassan	3,000	SLA	—
Argentina:				
Cia. General Asfaltos	Wilde (B. A.)	370	L	—
Esso Refinadora de Petroleo	Campana (B. A.)	18,000	Comp.	9,000T
	Bahia Blanca	6,000	SC	2,200T
	Manuel Eloridi	1,100	S	—
	Dadin	400	S	—
Condor	Avellaneda (B. A.)	1,000	SL	—
Diadema Argentina S. A. de Petroleo	Buenos Aires[1]	18,000	SC	8,000C
Ferrocarrilera de Petroleo	C. Rivadavia	6,000	Comp.	2,000T
La Isaura	Bahia Blanca	1,600	SC	1,000T
Loterro y Papini	Avellaneda (B. A.)	300	SL	—
Ragor S. A.	Quilmes (B. A.)	150	SL	—
Y. P. F. (Enoe)	Dock Sud-Avellaneda (B. A.)	6,000	Comp.	2,600T
	Puerto La Plata	85,000	Comp.	25,000T
	San Lorenzo (Santa Fe)	17,000	SC	6,200T
	Lujan de Cuyo (Mendoza)	5,000	SC	3,000T
	Chachapoyas (Salta)	1,900	SC	950T
	Plaza Huincul (Neuquen)	1,300	SC	570T
	Comodora Rividavia	5,500	SC	2,000T

[1] Reforming capacity 3,000 b/d. Lube plant for 1954 completion. Capacity 600 b/d.

Australia:				
Bitumen & Oil Refineries Ltd.	Sydney[1]	6,000	SA	—
Commonwealth Oil Refineries Ltd.	Laverton, Victoria	2,500	S	—
National Oil Pty., Ltd.	Glen Davis (Shale Oil)	1,500	SC	—
Shell Co. of Australia Ltd.	Clyde[2]	7,900	SA	1,500T
Vacuum Oil Pty. Ltd. (Standard-Vacuum)	Altona	2,500	SL	—

[1] 1,500 b/d catalytic reforming capacity.

[2] Capacity to be increased to 18,000 b/d by 1954. 250 b/d lube plant bldg.

Note: California Texas Oil Co. to build 22,000 b/d refinery at Sidney. Anglo-Iranian Oil Co. to build 62,000 b/d refinery at Kuinana. Shell is building 25,000 b/d plant at Geelong, completion planned for early 1954.

Austria:				
Vacuum Oil Co.	Kagran	2,100	SLA	—
A. G. der Shell-Floridsdorfer Mineraloelfabrik	Floridsdorf	3,400	SLA	—
Oesterreichische Mineraloelwerke (Soviet)	Lobau	4,850	S	—
Benzin-Bensolverband (Soviet)	Voesendorf[1]	2,100	SLA	—
Deutsche Erdoelwerke (Soviet) (Austrian Trusteeship)	Schwechat[1]	5,000	Comp.	3,840T
Deutsche Gasolin A. G. (Soviet)	Korneuburg[1]	4,000	S	—
Donau Oel G.M.B.H. (Soviet)	Moosbierbaum[1]	5,200	SC	3,500T
German Government (Austrian Trusteeship)	Hauskirchen[2]	1,400	S	—

[1] Located in the Austrian Federal Province of Lower Austria (Niederoesterreich), presently occupied by the Soviet Army.

[2] Located in the U. S. zone of Austria, in the Austrian Federal Province of Upper Austria (Oberoesterreich); refineries are not in operation at present.

Note: Soviet-operated refinery figures are estimates, not officially verified.

Bahrein Island:				
Bahrein Petroleum Co.	Persian Gulf[1]	155,000	SCA	36,700CT[2]

[1] 21,000 b/d fluid catalytic cracking, 15,700 b/d thermal.

[2] Modernizing cat cracker, increasing capacity to 26,000 b/d. Complete early 1953.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Belgium:				
"Albatros" S. A. Belge pour le Raffinage de Petrole	Antwerp, Kiel	3,500	S	—
Belgian Shell Co. S. A.	Ghent[1]	1,800	SLA	—
Compagnie Industrielle "Atlas" S. A. (Esso)	Hoboken-Antwerp[2]	2,000	S	—
Raffinerie Belge de Petroles	Antwerp	7,000	SCL	2,000T
Raffineries et Distilleries Anversoises S. A. "Radian"	Antwerp	1,700	S	—
Soc. Industrielle Belge des Petroles S. A.	Kruisschans-Anvers	40,000	SC	—[3]
Tankage et Transport S. A.	Antwerp	1,000	S	—
Bolivia:				
Yacimientas Petroliferous Fiscales Bolivianos	Cochabamba	5,000	S	—
	Sucre	3,000	S	—
	Camiri	1,450	S	—
	Sanandita	950	S	—
British Borneo:				
Sarawak Oilfields Ltd.	Lutong, Sarawak	38,500	S	—
Burma:				
Burmah Oil Co.	Chauk	2,000	S	—
	Rangoon	1,000	S	—
Nathsingh Oil Co. Ltd.	Yenangyaung	500	S	—
Canada:				
Anglo-Canadian Oil Ltd.	Brandon, Manitoba	3,000	SC	3,400T
British American Oil Co. Ltd.	Edmonton	5,750	SCA	4,400CT[4]
	Montreal East	40,000	SCA	24,400CT[4]
	Clarkson, Ont.	17,000	Comp.	4,500T
	Moose Jaw, Sask.	15,000	SCA	5,900CT[4]
	Calgary, Alberta	7,200	SCA	2,500T
Canadian Oil Companies Ltd.[5]	Sarnia	20,000	SC	14,000C
Excelsior Refineries Ltd.	Lloydminister	3,000	SA	—
Gas & Oil Refineries Ltd.	Hartell, Alberta	2,500	SC	1,500T
Hi-Way Refineries Ltd.	Rosetown	350	S	—
	Saskatoon	2,800	SCA	600
Husky Oil & Refining Ltd.	Lloydminister	7,500	SA	—
Imperial Oil Ltd.	Calgary	9,200	SCA	4,600C
	Edmonton	20,700	SC	18,500CT
	Halifax	22,000	SCA	10,000T
	Ioco, B. C.	12,000	Comp.	2,750T
	Montreal East[6]	44,000	SCA	23,700CT
	Norman Wells	1,250	S	—
	Regina	20,000	SCA	9,700CT
	Sarnia[6]	55,500	Comp.	27,000
	Winnipeg	10,800	SC	3,100
McColl-Frontenac Oil Co. Ltd.	Montreal East	43,000	SC	20,500CT
	Toronto	12,000	SC	7,000T
	Edmonton	5,500	SC	2,600C
Moose Jaw Refineries Ltd.	Moose Jaw, Sask.	1,500	S	—
New Brunswick Oilfields Ltd.	Weldon, N. B.	300	S	—
North Star Oil Ltd.	St. Boniface, Man.	5,000	SC	1,100T
Northern Petroleum Corp. Ltd.	Kamsack, Sask.	700	S	—
Prince Albert Refineries Ltd.	Prince Albert, Sask.	1,000	S	—
Radio Oil Refineries Ltd.	East Kildonan, Man.	1,000	S	—
Saskatchewan Federated Corp. Ltd.	Regina, Sask.	5,900	SC	2,450T
Shell Oil Co. of Canada Ltd.	Montreal East[7]	25,000	SC	17,500CT
Shell Oil Co. of B. C. Ltd.	Shellburn, B. C.	7,000	SC	3,000T
Standard Oil Co. of B. C. Ltd.	Stanovan, B. C.	8,350	S	—
Supreme Refineries, Inc.	Ogden	1,000	S	—
Trinidad Leaseholds Ltd.	Port Credit, Ont.	5,500	SC	3,000T
Wainwright Refineries Ltd.	Wainwright, Alberta	300	S	—

[1] Includes 2,000 b/d catalytic cracking.
[2] Includes 16,900 b/d catalytic cracking.
[3] Includes 4,400 b/d catalytic cracking.
[4] Includes 3,800 b/d Platformer.
[5] Cat. cracking capacity 12,200, reforming 3,000 b/d.
[6] Under construction, 46,500 b/d crude oil distillation unit to replace 31,000 b/d obsolete equipment and fluid catalytic cracking unit with a capacity of 23,250 b/d, probable completion Dec. 1952.
[7] 10,000 b/d fluid cracking unit.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Brazil:				
Conselho Nacional do Petroleo[1]	Bahia	150	S	—
	Mataripe[2]	2,500	SC	—
Distillaria Rio Grandense de Petroleo S.A.	Rio Grande	300	S	—
Industrias Matarazzo de Energia S.A.	Sao Paulo	500	S	—
Ipiranga S.A. Cia Brazilea de Petroleos	Rio Grande[3]	1,300	LA	—

[1] Conselho will erect a 45,000 b/d plant at Cubatao, near port of Santos. Completion planned for 1954. Consideration is being given to two other projects: a 45,000 b/d plant at Belem, Para, and a 40,000 b/d plant for the State of Rio de Janeiro.
[2] Capacity of this plant is to be doubled.
[3] A new 5,000 b/d refinery will be completed in Dec. 1952.

Refinaria e Exploracao de Petroleo Uniao is to build 20,000 b/d plant in Santo Andre, Sao Paulo. Planned for completion in 1953.

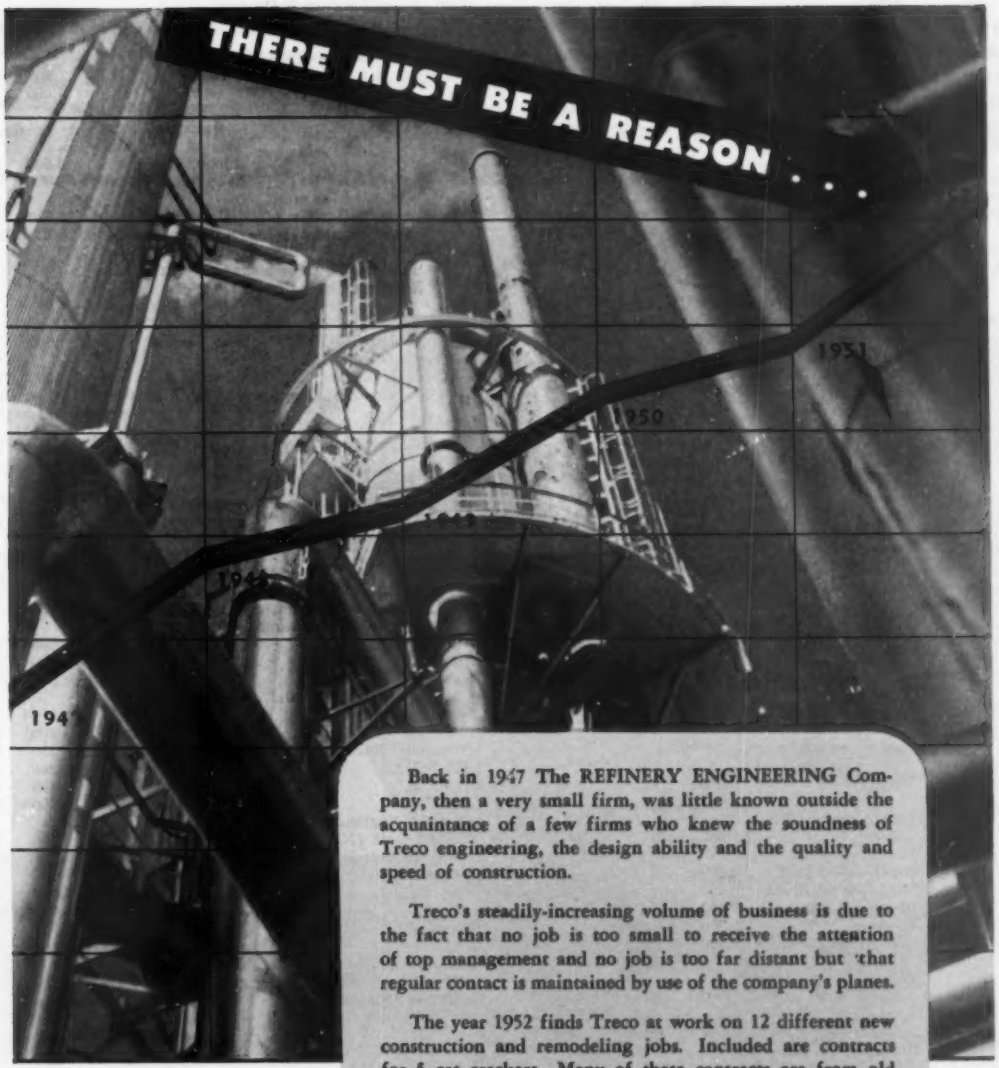
Refinaria de Petroleos de Manguinhos to build 10 000 b/d plant at Manguinhos, Rio de Janeiro, planned for completion in 1953.

Chile:				
Johannsen, C. H.	Coquimbo	125	S	—
Maritano, Miguel	Talcahuano	60	S	—
Soc. Establecimientes Quimicos	Vina del Mar	175	S	—

Empresa Nacional Del Petroleo is building an 18,000 b/d refinery with thermal cracking and reforming facilities.

China:				
Chinese Government	Kansu	1,000	S	—
Colombia:				
Colombia Petroleum Co.	Petrolea	900	S	—
Tropical Oil Co.	Barrancabermeja	32,000	SLA	—
Cuba:				
Cia. Exploradora de Petroleo	Jarahueca	400	S	—
Cia. Petrolera Jarahueca	Jarahueca	600	S	—
Cuban Oil Ref. Co.	Cabaiguan	800	S	—
Destiladora Jarahueca	Santa Clara	200	S	—
Esso Standard Oil Co.	Belot	5,000	Comp.	1,100T
Union Gas Co.	Bacaranao	300	S	—
Denmark:				
AA/S Kalundborg Olieraffinaderi	Kalundborg	650	A	—
Dansk Mineroloiliefabrik	Copenhagen	60	SL	—
L. C. Glad & Co.	Copenhagen	65	S	—
Ecuador:				
Anglo Ecuadorian Oilfields Ltd.	La Libertad	5,000	S	—
Manabi Exploration Co.	Cautivo	700	SL	—
Formosa:				
Chinese Petroleum Corp.	Kaoshiung, Taiwan	18,350	SCL	4,500T
France:				
Compagnie Francaise de Raffinage	La Mede[1]	47,000	SCA	3,000T
	Gonfreville l'Orcher	71,000	SC	4,000T
Compagnie de Raffinage Shell-Berre	Petit-Couronne	49,000	Comp.	4,900T
	Pauillac[2]	6,300	SA	—
	Berre[3]	63,000	Comp.	4,200C
Pechelbronn SAEM	Merkwiller	1,600	Comp.	200T
Raffineries Francaises de Petrole de l'Atlantique	Donges[4]	25,000	S	—
Raff. de Petrole de la Gironde	Bec d'Ambes[5]	16,500	S	—
Ste. Cherifienne des Petroles	Petitjean (Morocco)	1,300	S	—
Ste. Generale des Huiles de Petrole	L'Avera	39,000	S	—
	Dunkerque[6]	39,000	SL	—
Socony Vacuum Francaise	N. Dame de Gravenchon	17,500	Comp.	—
	Frontignan	25,000	SC	10,000C
Standard Francaise des Petroles	Port Jerome[7]	53,000	Comp.	—
	La Mailleraye	500	[8]	—

[1] Planned for 1953: 10,000 b/d cat. cracker.
[2] New 7,000 b/d crude still under construction.
[3] Thermal reforming capacity 12,400 b/d. 10,000 b/d cat cracker projected for late 1953 completion.
[4] Building 10,000 b/d catalytic cracking unit, mid-1953 completion.
[5] 3,500 b/d thermal reforming.
[6] Thermal reforming capacity 6,000 b/d.
[7] Planned for 1953: 10,000 b/d cat cracker.
[8] Medicinal and technical white oils, greases and special products.



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Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Egypt:				
Anglo Egyptian Oil Fields Ltd.	Suez	38,000	SCA	6,400T
Raffinerie de Petrole du Government	Suez	9,000	SA	—
Eire:				
Cork Harbour Oil Wharves Ltd.	Haulbowline Is. Co. Cork	600	S	—
Germany:				
Badische Anilin- & Soda-Fabrik	Ludwigshafen on Rhine	1,000	SL	—
BP Benzin-und Petroleum-GmbH. (Anglo-Iranian)	Hamburg-Finkenwerder	14,000	SC	6,300
Coelner Benzin-Raffinerie	Cologne	320[1]	[2]	—
Deutsche Erdoel-A.G.	Heide[3]	3,000	SLA	—
	Wietze	1,400	SLA	—
	Hamburg-Grasbrook	1,600[1]	L	—
Deutsche Gasolin A.G.	Dollbergen-Lehrte	2,500	SLA	—
Deutsche Shell A.G.	Hamburg-Harburg	9,600	SLA	—
	Monheim on Rhine	4,000	SLA	—
	Hamburg-Grasbrook	1,700[2]	L	—
	Duesseldorf-Reisholz	900[2]	[2]	—
	Hamburg-Wilhelmsburg	850[2]	[2]	—
Deutsche Vacuum Oel A.G.	Bremen-Oslebshausen[3]	12,700	SL	—
	Wedel on Elbe	750[2]	L	—
Esso A.G. (Standard Jersey)	Hamburg-Harburg[4]	15,000	SLA	—
Gelsenberg Benzin A.G.	Gelsenkirchen	17,000	SH	7,600[5]
Gewerkschaft Deurag-Nerag	Misburg n. Hannover[7]	11,200	Comp.	3,800
George Greiser/Pfeifer	Dollsbergen	500	SL	—
Johann Haltermann	Hamburg-Welhelmsburg	2,000[2]	[2]	—
Kraftstoff-Handelsgesellschaft mbH.	Essen	750	S	—
Mineraloel- & Asphaltwerke A.G. (MAWAG)	Ostermoor on Kiel Canal	1,300	SA	—
Mineraloelwerke Albrecht & Co.	Hamburg-Grasbrook	250[2]	L	—
Mineraloelwerke Peine (Schindler)	Peine	380	SL	—
Mineraloelwerke Albert Sengewald	Dedenhausen (Hannover)	900	SL	—
Oelwerke Julius Schindler GmbH.	Hamburg-Neuhof	4,200	SL	—
Ruhrbau GmbH.	Muelheim on Ruhr	2,100	S	—
Ruhrchemie A.G.	Oberhausen-Holten	5,300	S	—
Ruhrol GmbH.	Bottrop	5,300	S	—
Scholven-Chemie A.G.	Gelsenkirchen-Bauer	8,500	SH	—
Union Rheinische Braunkohlen-Kraftstoff A.G.	Wesseling n. Cologne	17,000	SH	6,300[6]
Wintershall A.G.	Salzbergen (Emsland)	2,000	Comp.	500
Zeller & Gmelin	Eislingen (Wuerttemberg)	170	SL	—

[1] Half-finished products charging capacity.

[2] Type of plant gasoline rerunning.

[3] Undergoing expansion. Plan to increase crude oil charging capacity to 9,500 b/d with catalytic cracking unit for completion 1952.

[4] Intake capacity for Hydrogenation. H-Hydrogenation.

[5] Plan an 8,000 b/d TCC catalytic cracking unit for completion 1952.

[6] Plan to increase crude oil charging capacity to 29,000 b/d with cracking capacity and naphtha reforming capacity for completion January 1954.

[7] Reforming unit for 2,000 b/d planned for completion 1952.

Hawaiian Islands:

Pacific Refiners, Ltd.	Honolulu, Oahu[1]	3,000	A	—

[1] Operates on reduced crude and butane.

Hungary

The Petrochemia refinery at Szoeny now is being rebuilt. It is planned to resume operations in October 1952. Operations of the Cspel plant on Cspel Island in the Danube at Budapest have been low in recent months due to crude shortage and a fire.

Iran:

Anglo-Iranian Oil Co.[1]	Abadan	500,000	Comp.	130,000CT
	Kerminshah	2,100	S	—
	MIS[2]	70,000	T	—

[1] Refineries now under control of Persian government.

[2] Crude topping plant for Abadan refinery; makes no finished products, ships tops or bottoms to Abadan by pipe line as required for finishing.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
India:				
Assam Oil Co.	Digboi	5,500	SC	1,500T
Shell and Standard-Vacuum interests are planning erection of large refineries. Shell plant at Bombay to have capacity of 40,000 b/d, Stanvac plant capacity will be 25,000 b/d.				
Indonesia:				
N. V. de Bataafsche Petroleum Mij. (Shell)	Balik Papan, N.E. Borneo[1]	27,000	SW	—
	P. Brandan, Sumatra[2]	—	—	—
	Pladju, Sumatra[2]	83,000	SC	10,000T
	Tjepu, Java	3,600	S	—
	Wonokromo, Java	2,000	SA	—
N. V. Standard Vacuum Petroleum Mij.	Palembang, Sumatra	64,000	Comp.	31,000T

[1] Crude capacity being increased to 44,000 b/d. Completion planned in 1955.

[2] Inaccessible, former capacity 23,000 b/d.

[3] Reforming capacity 15,000 d/d.

Iraq:

Iraq Petroleum Co.	Bab Gurgur	1,500	S	—
Kanaquin Oil Co. Ltd. (Anglo Iranian)	Alwand	8,000	S	—
Government of Iraq plans to build 1,000 b/d plant at Baiji.				
Israel:				
Consolidated Refineries Ltd.	Haifa	83,000	SCA	33,000T
Italy:				
Anonima Petroli Italian (API)	Falconara	14,000	S	—
Asfalti Bitumi-Catrami e Derivati (ABCD)	Ragusa, Sicily	100	A	—
Aurora	Marghera, Venice	400	S	—
Bianchi Petroli	Cologno Monzese	800	S	—
Delle Piane	Genoa	250	S	—
Distilleria Italiana Catrami Affini—(DICA)	Carrara	1,300	S	—
Galletti	Florence	1,500	S	—
Garrone	Genoa	1,500	S	—
Industria Raffinazione Oil Minerali (IROM)	Marghera, Venice	30,000	SC	1,000T
I.C.I.P.	Mantova	300	S	—
Idrocarburi Nazionali (SIN)	Pietramala, Florence	250	S	—
I.P.L.O.M.	Busalla, Genoa	250	S	—
I.L.S.E.A.	Valmadrera, Como	400	S	—
I.N.P.E.T.	La Spezia[1]	17,000	SA	—
Industria Nazionale Olii Lubrificanti (NILO)	Milan	500	S	—
Lombarda Petroli	Villasanta	1,700	S	—
Permolio	Genoa	2,000	SA	—
	Milan	3,200	SLA	—
	Rome	2,000	SA	—
Petroli d'Italia	Fiorenzuola d'Arda, Parma	2,200	S	—
Raffinerie Siciliane Olii Minerali (RASIOM)	Augusta, Sicily	10,000	S	—
Raffineria Olii Lubrificanti (ROL)	Viguzzolo, Alessandria	1,400	SL	—
Ricerche Alta Italia	Rallio, Piacenza	50	S	—
Raffineria di Napoli (Socony-Vacuum)	Naples	33,000	SL	5,000T
Sanquirico	Genoa	250	S	—
Societa per Azioni Raffineria Padana Olii Minerali	San Martino di Trecate	13,300	S[2]	—
Societa Petrolifera Italiana	Fornovo Taro, Parma	600	S	—
STANIC (Esso and ANIC)	Bari	27,000	SC	3,500
	Leghorn	17,000	SC	4,000
Societia Industrie & Commerce Olii Minerale	Florence	500	S	—
Volpato	Milan	250	S	—

[1] Crude capacity being increased to 30,000 b/d. Completion planned in early 1953.

[2] Thermal reforming capacity 3,150 b/d.

Note: Pantanedo di Rho "CONDOR" is erecting a 10,000-barrel refinery at Rho, Milan. Completion will be in December 1952.

Korea:

Plant destroyed.

Kuwait:

Kuwait Oil Co. Ltd.	Mina El Ahmadi, Persian Gulf	25,000	S	—

Lebanon:

Iraq Petroleum Co. Ltd.	Tripoli	11,000	S	—

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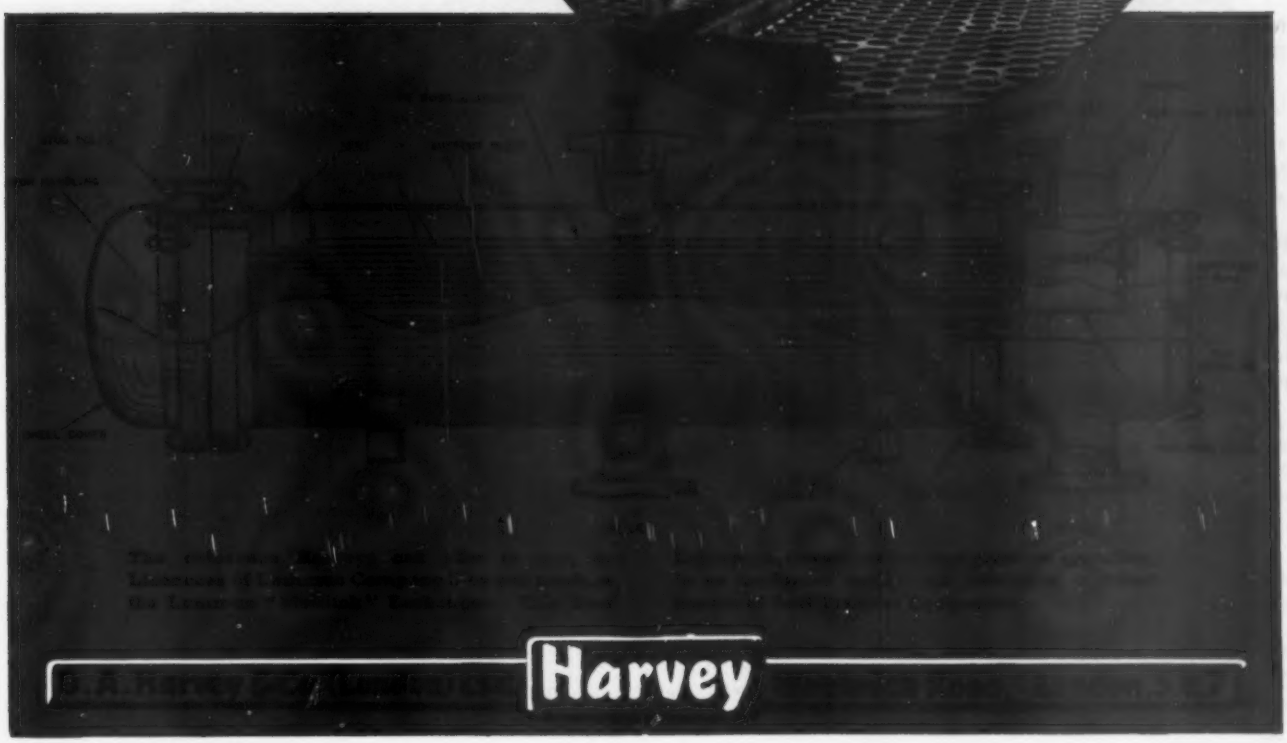

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Japan:				
Daikyo Oil Co.	Yokkaichi	6,000	SLA	—
Koa Oil Co.	Marifu[1]	10,000	Comp.	1,500T
Maruzen Oil Co.	Shimotsu	9,000	SLA	—
	Matsuyama	4,000		
Mitsubishi Oil Co.	Kawasaki	6,100	SLAC	2,500T
Nippon Mining Co.	Funakawa	5,000	SLA	—
Nippon Oil Co.	Akita	3,500	SLA	—
	Kashiwazaki	1,200	SLA	—
	Niigata	1,900	SLA	—
Nippon Pet. Ref. Co. Ltd.	Yokohama[2]	12,000	SLA	—
	Kuadamatsu[3]	7,000	SLA	—
Showa Oil Co.	Kawasaki	8,000	SLA	—
	Hirazawa	800	SLA	—
	Niigata	2,400	SLA	—
Toa Nenryo Kogyo Co.	Shimizu	5,100	SLA	—
	Wakayama	10,100	Comp.	3,000T

[1] Building platformer 1,300 b/d, complete 1953-54.
[2] Cat cracker planned for 1954-55 completion.
[3] Building 1,300 b/d platformer to be completed in 1953-54.

Mexico:				
Petroleos Mexicanos	Arbol Grande, Tampico	22,000	SLA	—
	Atzapotzalco, D. F. Mexico	50,000	SC	14,500T
	Ciudad Madero, Tampico[1]	75,000	A	5,500T
	Mata Redonda, Veracruz	15,000	SC	8,000
	Minatitlan, Veracruz[2]	28,000	L	—
	Poza Rica, Veracruz	4,000	S	—
	Reynosa, Tampico	5,000	S	—
	Salamanca, Gto.[3]	30,000	SC	5,000T

[1] In progress 10,000 b/d gasoline catalytic desulfurization to be completed December 1952.
[2] Planned an 8,000 b/d catalytic cracking unit and complete revamping of refinery.
[3] In progress, increase throughput capacity to 50,000 b/d and installation of lubricating plant to produce 2,000 b/d of oil and 65 tons daily of wax including vacuum fractionation, MEK dewaxing, propane deasphalting, furfural and earth treating.

Netherlands:				
N. V. de Bataafsche Petroleum Mij (Shell)	Pernis	100,000	Comp.	45,000TC[1]
Caltex Petroleum Mij N. V.	Pernis[2]	28,000	Comp.	6,400T

[1] 20,000 b/d thermal, 25,000 b/d catalytic. Reforming capacity 8,500 b/d. Plans are to increase crude capacity to 165,700 b/d in 1953.
[2] 6,500 b/d thermal reforming capacity.

Netherlands West Indies:				
N. V. Curacaosche Petroleum Industrie Mij.	Aruba	30,000	S	—
	Curacao[1]	200,000	Comp.	100,000T[1]
Lago Oil & Transport Co.	Aruba	400,000	Comp.	292,970

[1] Reforming capacity 18,000 b/d. Lube capacity being expanded to 21,000 b/d. Completion planned for late 1953.

Norway:				
A/S Ozlandske Petroleumscompagni	Vallo	1,000	S	—
Pakistan:				
Attock Oil Co.	Punjab, Rawahlpindi	4,000	Comp.	1,500T
Peru:				
Cia. de Petroleo Ganzo Azul	Agua Caliente	600	S	—
Empresa Petrolera Fiscal	Zorritos	1,300	S	—
International Petroleum Co.	Talara	35,600	SLA	3,000T

Poland

The refinery at Glinnik in southeastern Poland which was partly destroyed during the war has now been rebuilt with the aid of equipment supplied by the USSR.

Portugal:				
"Sacor" S. A. Concessionaria de Refinacao de Petroleos em Portugal	Cabo Ruivo[1]	7,000	S	—

[1] Planned: 10,000 b/d topping, 5,000 b/d cracking, 2,500 b/d reforming; also stabilization and polymerization units.

Romania

At the request of the USSR, the Romanian monopoly, Sov-Rum Petrol, is dismantling a former refinery at Ploesti for shipment to Soviet Russia. Before the war Romanian refineries had a crude capacity of 220,000 b/d. Many were destroyed or badly damaged. Current capacity is estimated at 103,000 b/d.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Saudi Arabia:				
Arabian American Oil Co.	Ras Tanura[1]	160,000	S	—

[1] Naphtha reforming capacity 24,500 b/d. Phosphoric acid catalytic polymerization unit capacity of 1,050 b/d polymers, estimated completion late 1953.

South Africa:				
So. Africa Torbanite Mining & Refining Co.	Boksburg North, Transvaal	2,000	SCA	2,000T

[1] Standard Vacuum Ref. Co. of So. Africa Pty. is building 25,000 b/d refinery at Durban.

Spain:				
"Campsa" Cia. Arrandataria del Monopolio de Petroleo S. A.	Barcelona	300	SL	—
"Cepsa" Cia. Espanola de Petroleo S. A.	Canary Islands	20,000	Comp.	4,000T
Refineria de Petroleos de Escombreras, S. A.	Escombreras[1]	30,000	S	—

[1] Thermal reforming capacity 8,200 b/d.

Sweden:				
Johnson & Co., A.	Nynashamm	12,000	Comp.	1,000T
	Malmo	1,900	A	—
Koppartrans Oljeaktiebolag	Goteborg	11,000	S	—
Svenska, Skifferolje A/B	Narkes-Kvarntorp[1]	1,000	S	—

[1] Shale oil plant.

Switzerland:				
Ipsa A. G.	Rotkreuz[1]	1,500	S	—
Schweiz-Sprengstoffabrik A. G.	Dottikon[2]	350	—	—

[1] Operates on tops.
[2] Manufactures special naphthas.

Trieste:				
Aquila S.A. Tecnico Industriale	Trieste	13,500	SL	—
Standard Esso	Trieste	2,330	SLA	—

Trinidad:				
Brighton Terminal Ltd.	Brighton	4,000	S	—
Trinidad Lake Asphalt Operating Co.	Brighton	1,000	A	—
Trinidad Leaseholds Ltd.	Point-a-Pierre[1]	70,000	Comp.	25,000T
United British Oilfields of Trinidad Ltd.	Point Fortin	30,000	SA	—

[1] 25,000 b/d reduced crude thermal cracking; 10,000 b/d naphtha reforming; 15,000 b/d fluid cat cracking with vacuum feed preparation unit and vis-breaker under construction.

United Kingdom:				
Anglo-Iranian Oil Co. Ltd.	Isle of Grain, Kent[1]	40,000	Comp.	—
Berry, Wiggins & Co. Ltd.	Hoo, Kent[2]	2,000	SLA	—
	Salford (Nr. Manchester)	1,500	SLA	—
Briggs & Co. Ltd., Wm.	Dundee, Scotland	1,000	LA	—
Carless, Capel & Leonard	London	200	S	—
Esso Petroleum Co. Ltd.	Fawley	130,000	Comp.	41,000C
Lobitos Oil Fields Ltd.	Ellesmere Port	2,500	Comp.	1,000T
London & Thameshaven Oil Wharves, Ltd.	Thameshaven	2,000	LA	—
Manchester Oil Refy. Ltd.	Trafford Park[3]	3,000	Comp.	—
National Oil Refineries Ltd.	Llandarcy, S. Wales[4]	80,000	Comp.	10,000C
Scottish Oils, Ltd.	Grangemouth, Sct.[5]	45,000	SC	10,000C
	Pumpherston, Sct.[6]	3,700	SC	—
Shell Refining & Marketing Co. Ltd.	Ardrossan, Scot.	4,300	A	—
	Shellhaven, Essex[7]	60,000	Comp.	—
	Stanlow, Ellesmere Port[8]	85,000	Comp.	25,000
	Heysham, Lancas.[9]	36,000	S	—
Vacuum Oil Co. Ltd.	Coryton, Essex[10]	16,000	L	—

[1] Erection commenced mid-1950, to be completed in three stages, 1st stage complete mid-1952, second stage lubricating oil and third stage catalytic cracking to be completed early 1953.
[2] New two-stage distillation unit being erected.
[3] 3,500 b/d atmospheric distillation still to be completed in Nov. 1952.
[4] 10,000 barrel catalytic cracker due for completion 1952.
[5] 10,000 barrel cat. cracker due for completion 1952.
[6] Capacity includes 2,500 b/d Shale oil and 1,200 b/d U. K. crude oil.
[7] Reforming capacity 10,000 b/d.
[8] Reforming capacity 10,000 b/d.
[9] Reforming capacity 5,100 b/d, vis breaking capacity 8,300 b/d.
[10] Erection commenced. Commencement of operation late 1952.

(Concluded on page 122)

Oil Refinery Construction at Coryton

4,200-TON reinforced concrete caisson in position at Coryton after its ten mile down river journey from Tilbury. This structure forms part of the water intake jetty for the new oil refinery at Coryton under construction for Vacuum Oil Company Limited in conjunction with the Lummus Company Limited.

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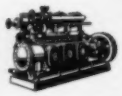

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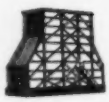

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Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Turkey:				
Maden Tetkik Ve Arama Enstituso	Batman[2]	420	S	—

[2] A refinery of 3,500 b/d capacity including thermal cracking and naphtha reforming units is planned.

Uruguay:				
Administration Nacional de Combustibles, Alcohol y Portland (ANCAP)	Montevideo	25,200	SCA	2,000

U. S. S. R.:

The government has announced an increase in capacity during 1951 of 120,000 b/d. It is estimated that crude capacity now approximates 920,000 b/d, cracking capacity 300,000 b/d.

Venezuela:				
British Controlled Oilfields	El Mene de Mauroa	250	S	—
Creole Petroleum Corp.	Amuay Bay	60,000	S	—
	Caripito	57,000	SC	25,000T
Mene Grande Oil Co.	Oficina	300	S	—
Phillips Oil Co.	Santa Ana	2,000	Wax	—
Shell: Colon Development Co. Ltd.	Casigua	1,000	S	—
	La Rivera	300	S	—
	El Calvario	300	S	—
Shell-Caribbean Petroleum Co.	San Lorenzo	45,000	S	—
Venezuelan Oil Concessions Ltd.	Punta Cardon[1]	75,000	SCL	32,000T
Sinclair Oil & Refining Co.	Puerto La Cruz	35,000	S	—
Texas Petroleum Co.	Tucapita	10,000	S	—
Venezuela Gulf Refining Co.	Puerto La Cruz[2]	40,000	SC	32,000T

[1] Crude capacity is being increased to 170,000 b/d. Completion is planned for 1953 at which time San Lorenzo may be shut down.
[2] Handles Mene Grande and Texas Company crudes.

Yugoslavia:				
Government	Rijeka	7,000	SLAC	600
	Sisak	2,000	S	—
	Bosanski Brod	1,500	S	—

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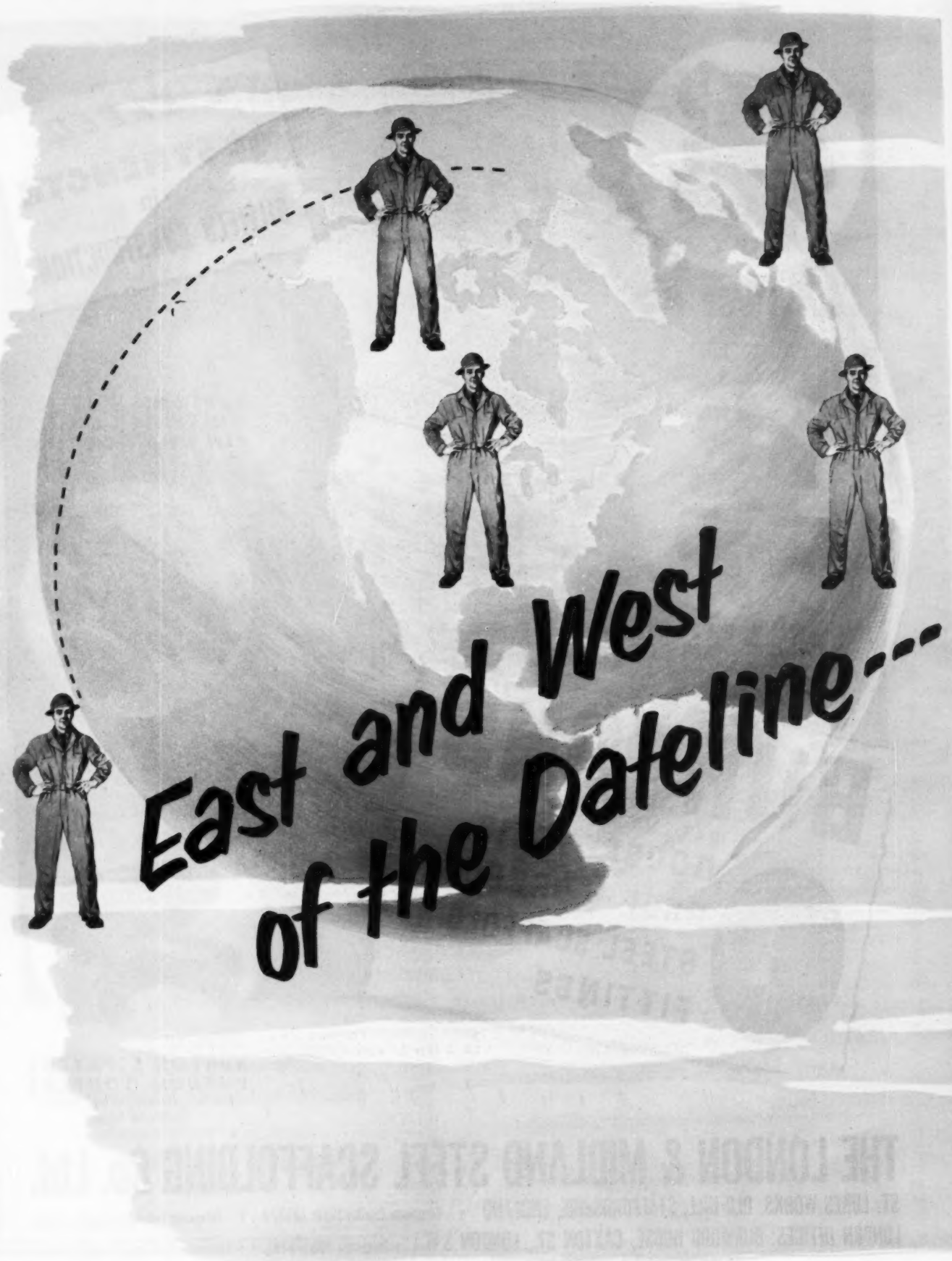
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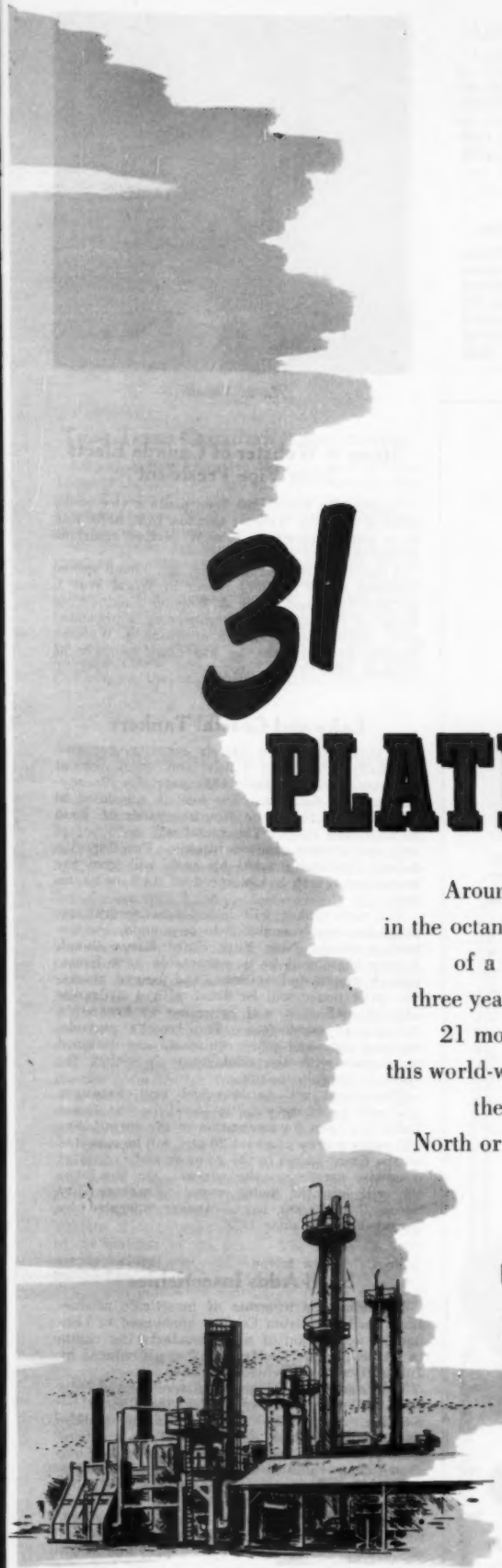

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New Acetylene Ethylene Process Announced

The Wulff Process Co., has entered into agreements with the Lummus Co. of New York, The Fluor Corp., Ltd. of Los Angeles and Girdler Corp. of Louisville under which these companies are authorized to design and construct plants for applications of the Wulff Process for making acetylene and ethylene.

Wulff has been operating a commercial size pilot plant in Maywood, California for the past 18 months, and during the last nine months of this period the plant has been in continuous commercial production of acetylene.

The process uses natural gas, ethane, propane, butane, or any LPGas mixture as feed stock. It may be applied to plants making as little as one ton per day or as much as 100 tons per day. The process is also applicable to the production of ethylene or simultaneous production of acetylene and ethylene.

New Polystyrene Plant

Chemical Plants Division of Blaw-Knox Co. has received a contract from Catalin Corp. of America to design and construct a plant for the production of polystyrene. To be built at Calumet City, Ill., the new plant will have facilities for producing monthly 1,200,000 pounds of dye color powder and standard extruded pellets of polystyrene.

American Locomotive Promotion

David D. Frank has been appointed director of information and Daniel J. Duffin promotion manager of American Locomotive Co. Mr. Frank is now in charge of Alco press relations and company publicity. Mr. Duffin is responsible for company advertising and product promotion for the Alco products, Diesel Engine and Railway-Steel Springs Divisions.

L. L. Youell

Stone & Webster of Canada Elects New Vice President

Leonard L. Youell has been made a vice president of Stone & Webster Canada Ltd., according to an announcement by John W. McKee, chairman of the board.

A native of Aylmer, Ontario, Mr. Youell served overseas as an artillery officer in World War I. In 1945 he joined Stone & Webster Engineering Corp. in Canada as its engineering representative. Since the formation of Stone & Webster Canada Ltd. in 1950, he has been manager of its head office in Toronto.

Lake and Coastal Tankers

A tanker of 24,000 barrels capacity, designed especially for Great Lakes and short coastal operation, will be built this year for Socony-Vacuum Oil Co., Inc. The keel is scheduled to be laid July 15 at the Houston yards of Todd Shipbuilding Corp. The vessel will be 300 feet long and of 3,600 deadweight tons. Two Superior diesels developing 1,080 hp each will give the twin-screw craft a top speed of 14.5 miles an hour.

The new tanker will incorporate several unusual features to enable it to pass under the low bridges of the New York State Barge Canal. Among these will be a retractable pilot house, folding masts and railings, and hinged stacks. The pilot house will be fitted with a hydraulic lift with which it will be raised or lowered a distance of eight feet. The vessel's controls, steering gear and other equipment are designed to operate with the pilot house in either the "up" or "down" position.

The vessel will be launched next February and will be in service by the time the Great Lakes are open for navigation in the spring. She will carry a crew of about 20 and will be operated on the Great Lakes in the summer and in limited coastwise service in the winter. On the lakes she will join the motor vessel "Traverse City Socony," a 28,000 barrel tanker operated by Socony-Vacuum since 1938.

Shell Adds Insecticides

Extending its program of insecticide production, Shell Petroleum Co. has announced in London its acquisition of sole manufacturing rights to "Aldrin" and "Dieldrin" hitherto produced by Julius Hyman of Denver, Colorado.

The names of these products were derived from well known chemical synthetics, the Diels-Alder reaction, the principal raw material being dicyclopentadiene, which can and will be produced from petroleum. Tests on these insecticides have shown their value in the control of soil insects, cotton pests, locusts and grasshoppers, ants and many other insects. Dieldrin is of high value in the control of anopheline mosquitoes, the carriers of malaria. Aldrin has proved exceptionally efficient for control of grasshopper and locust pests.

Benches A and B Distillation Plant of the National Oil Refineries Limited at Llandarcy, South Wales, where the throughput is 80,000 barrels per day. Lincoln arc-welding again, of course.

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H. E. Boynton

Tube Turns Canadian Appointment

John G. Seiler, executive vice president of Tube Turns of Canada, Ltd., has announced the appointment of Harry E. Boynton as district manager for Western Canada. Mr. Boynton will make his headquarters in Edmonton, Alberta.

Mr. Boynton was born in Toronto, Ontario, and obtained his degree in mining engineering at the University of Toronto. He began his business career on the engineering staff of The International Nickel Co. of Canada, Ltd. Before joining Tube Turns of Canada, Ltd. in December, 1951, he was chief engineer of Eldorado Mining & Refining (1944) Ltd., and was stationed at Port Radium, on the east shore of Great Bear Lake.

New Chemical Plant for Cyanamid

American Cyanamid Co. will build a plant near New Orleans, La. for the production of chemicals from natural gas, according to an announcement by President K. C. Towe. This will place Cyanamid in the vast field of basic production from hydrocarbons, a development which is expected to add a substantial number of new items to the list of more than 5,000 products already manufactured by the company.

The new plant, for which a certificate of necessity was recently issued by the government, will represent an investment of about $50 million and will be located on a 600-acre site in Jefferson Parish, Louisiana.

As initially projected, the plant will produce ammonia, acetylene, hydrocyanic acid and derivatives of these products, among them acrylonitrile and ammonium sulfate. These basic materials provide a foundation for the eventual production of a wide range of both hydrocarbon and nitrogen chemicals for industrial use and for agricultural purposes.

Chemical Construction Corp., a subsidiary of American Cyanamid Co., is the architect-engineer and construction manager of the plant. A construction sub-contract has been awarded to the J. A. Jones Construction Co. of Charlotte, N. C. Various New Orleans contractors will participate in the building of the plant. The Texas Co. will supply natural gas, while power will be supplied by the Louisiana Power and Light Co.

New Lube Additive

Development of a new additive for lubricating oil which will permit efficient use of fuels with high sulfur content under "severest operating conditions" was announced today by Howard E. Nehms, manager of the Petroleum Chemicals department of American Cyanamid Co. The new product, Aerolube 92, combines oil antioxidant and bearing corrosion inhibition properties with "highly effective alkaline detergency." It was designed specifically for use in Series 2 oils. It will be particularly useful wherever poor fuels are used under severe operating conditions.

Additive Plant for Indiana Standard

Standard Oil Co. (Ind.), will build a new plant at its Wood River, Ill., refinery to expand the production of an improved detergent additive used in compounding heavy duty motor oils, it is announced by Dr. M. G. Paulus, vice president in charge of manufacturing. The new plant is being designed by Standard. Construction will begin soon, with completion scheduled for next year.

File-To-Field Service Units

Carl B. Whyte, executive vice president of Procon Inc., has announced that the company is ready to provide file-to-field construction service on Standard A, B, and C Platforming Units of 600, 1,000, and 1,500-barrel design capacities from drawings already in the company's engineering files.

Vapor Pressure Study

"Pressure-Volume-Temperature Relationship of Organic Compounds," by Robert R. Dreisbach; 3rd edition; published 1952 by Handbook Publishers, Inc., Sandusky, Ohio; 315 pages; $10.

This volume gives the variations of vapor pressure with temperature of organic liquids of almost every type—hydrocarbons, alcohols, esters, ketones, etc. It gives a ready means of ascertaining their latent heats of vaporization at any temperature, the rate of change of boiling point with pressure, vapor densities at various temperatures, and other essential information for conducting operations of distillation and evaporating such liquids, and designing equipment therefor. Oil refinery technologists will find there full data relating to liquid hydrocarbons of every kind in greater detail and with greater accuracy, according to the publishers, than in any similar handbook heretofore available.

HIGH ALUMINA CEMENT IN OIL REFINERIES

By T. D. Robson*

EVER-INCREASING use is being made of the special properties of high-alumina cement in the construction of oil refineries, but although this material is now well known to the civil engineer and to the furnace designer, its versatility is perhaps not fully appreciated. Contractors are familiar with one or another of its capacities but owing to the great variety of uses, a general understanding of the field which can be covered is sometimes lacking. The following article therefore attempts to survey, with special reference to oil refineries, the characteristics of the varieties of concrete or mortar which can be made with it.

High-alumina cement may on occasions be referred to as "aluminous cement," "ciment alumineux," calcium-aluminate cement," or "schmelz zement" according to the country of origin, and the best known proprietary names are Ciment Fondu (British and French), Lightning (British), Lumnite (American), Citadur (Hungarian), and Kolandshütte (German). All these brands fall into the broad classification of high-alumina cement since they consist essentially of calcium aluminate in contrast to the calcium silicate type exemplified by Portland cement. In general, the properties of these cements are therefore very similar, but not all those mentioned are identical in composition or method of manufacture.

The three chief properties which lead to the employment of this comparatively expensive type of hydraulic cement are:

(1) Resistance to a wide variety of chemical agents which can attack Portland cement.

(2) Extreme rapidity of hardening, following on a normal setting time.

(3) Suitability for use as a bond for refractory or insulating aggregates (thus producing refractory concrete and insulating concrete). With various types of heat-resistant grogs, high-alumina cement gives concretes which will withstand temperatures up to 1350°C (2500°F.). Indeed, with special aggregates, the temperature limit may be extended to the 1500°-1600°C. (2700°-3000°F.) range.

Its chemical resistance arises mainly from the fact that the hydration of high-alumina cement does not produce the free lime which appears in set Portland cement. Owing to the different chemical nature of the high-alumina cement, relatively inert gelatinous alumina is formed in place of the highly reactive lime constituent. This confers on high-alumina cement concrete a considerable resistance to dilute acids—for example, it will withstand the action of sulfuric acid effluents having a pH 3-4. The concrete also resists the action of sulfur dioxide and hydrogen sulfide, and has been found very suitable for protecting tanks, pipes, and vessels from the action of sour crudes. It may also be used for floors and drains, or for coating pipes to protect them from aggressive ground waters or treatment liquors. In any situation where acid resistance is required, it is equally important that the aggregate will not be attacked, and therefore silica sands and gravels (free from carbonates) or other inert materials should be employed.

High-alumina cement is completely immune from the action of sulfates although the latter have a specific action on Portland cement concrete which can result in expansion and ultimate disintegration. Since many refineries are built on ground which is badly contaminated with mineral sulfates, the use of high-alumina cement for piles, foundations, slabs and other structural features may be necessary.

Hydrocarbons should themselves have little or no action on Portland cement, but lubricating oils with a vegetable oil component frequently have a disintegrating action. High-alumina cement concrete has a much higher resistance in such cases and can generally be regarded as immune.

The behavior of high-alumina cement towards caustic alkalis is not as good as that of Portland cement, probably because the protective alumina is fairly readily soluble in alkali although it dissolves only with difficulty in dilute acid.

In many situations where high-alumina cement is used for chemical resistance, the second property of ultra-rapid hardening is very helpful since all structures made with this cement can be put into service within 24 hours of casting. Indeed, the concrete is frequently ready for use much before this time. The strength of high-alumina cement concrete at 24 hours is equal to or greater than that of Portland cement concrete at 28 days.

A good idea of the comparative concrete strengths of various type of Portland cement and of high-alumina cement can be obtained from Fig. 1.

Contrary to a fairly widespread belief, high-alumina cement is not quick setting and, in fact, the setting-time is often much longer than that of ordinary Portland cement. The difference lies in the subsequent hardening or development of strength which in the case of high-alumina cement is extremely rapid.

In order to obtain the best results from high-alumina cement, all concrete work should be kept wet and cool from the time of setting until it is at least 24 hours old. The great activity of this type of cement in early stages produces an appreciable temperature rise in any mass of concrete and this is very valuable for protection against frost when concreting must be carried out in very cold weather. On the other hand, when atmospheric temperatures are high, it is essential to keep the temperature rise within bounds by restricting the size of lift, by removing forms as soon as possible, and by sprinkling with water in order to prevent overheating and consequent loss in strength. For the same reason high-alumina cement concrete should never be steam-cured since lower, not higher, strengths will result from this treatment.

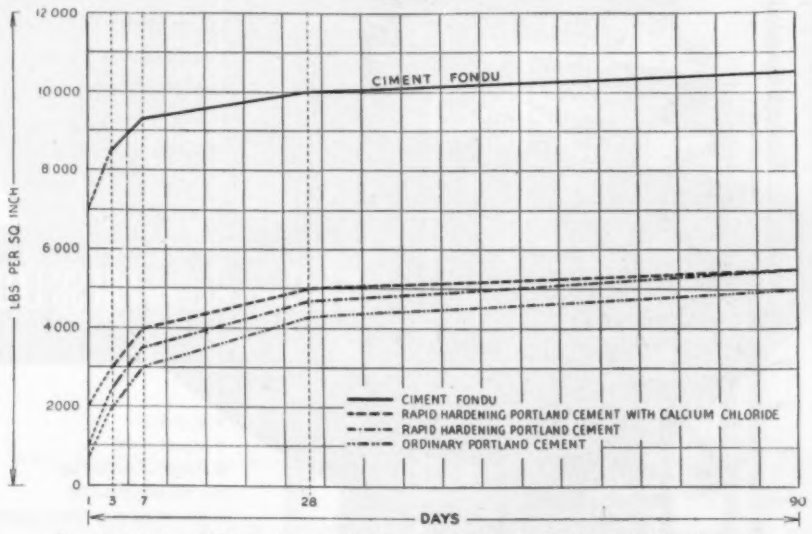
The third characteristic of high-alumina cement has led to perhaps the most interesting and growing application in oil refinery work and it is therefore proposed to deal in more detail with the type of concrete which can be used at higher temperatures.

There is much controversy about fixing the "safe" temperature which Portland cement concrete can sustain for long periods but it is probably true that this material should not be submitted to temperatures much above 200°C. (400°F.). Hardened Portland cement contains a considerable proportion of hydrated lime and the quick-lime produced from this at comparatively low temperatures can exert strong disruptive forces when it re-hydrates in moist air. At still higher temperatures more lime may be formed by calcination of carbonate or from the calcium silicates of the cement, and over-heated Portland cement concrete may thus crumble to powder several days after the application of heat because moisture has then had time to penetrate the mass. The absence of free lime from hardened high-alumina cement ensures its immunity from this defect at all temperatures up to the refractory limit of the concrete. The substitution of this cement for Portland cement is therefore the first step towards producing a heat-resistant construction. The type of aggregate is obviously the other important factor and Table 1 shows, in a very general fashion, the suggested temperature ranges for concretes or mortars made with high-alumina cement and several aggregates, both naturally-occurring and manufactured.

* *Technical Director, Lafarge Aluminous Cement Company.*

FIGURE 1

Compressive strength of 1:2:4 concrete from 1 day to 90 days.
Test specimens gauged with a water/cement ratio of 0:60 stored in air at 64° temperature and 65% relative humidity.



This graph is compiled from data supplied by permission of the Director of Building Research.

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TABLE I

High-alumina Cement Concretes

Aggregate	Temperature Range	Classification
Silica gravels and sands	Atmospheric to 250°C. (500°F.)	Heat-resistant concrete
Trap-rock or whinstone	Atmospheric to 500°C. (950°F.)	" " "
Crushed clay building brick, engineering brick	Atmospheric to 1000°C. (1800°F.)	" " "
Crushed firebrick (alumino-silicate)	Atmospheric to 1350°C. (2500°F.)	Refractory concrete
Sillimanite, Chrome, Chrome-magnesia, Carborundum, Fused alumina.	Atmospheric to 1400°C.-1600°C. (2550°F.-2900°F.)	Special refractory concrete

Even when used with high-alumina cement, silica sands, gravels and quartz can be employed only for the lowest temperature range because the thermal expansion of siliceous aggregate is high and because inversion of the quartz takes place at higher temperatures. Limestone or dolomite aggregate is better in the lower ranges but an upper limit is set by thermal dissociation into reactive lime or magnesia.

Trap-rock aggregate is very useful for the medium temperature range because the concrete made from it is denser and more wear-resistant than brick concrete, but care should be taken to ensure that the temperature limit is not exceeded. Unfortunately, the terms "trap-rock" and "whinstone" are often applied very loosely and suitable heat-resistant concrete should be made only from fine-grained basic igneous rock such as dolerite, gabbro, or basalt. The coefficient of expansion of this class of aggregates is usually about 0.0000022 per °F. as compared to 0.0000067 per °F. for quartz.

Crushed clay building brick, engineering brick, or clay tile make suitable aggregates for concrete which will not be heated above about 1000°C. (1800°F.) and such concrete is therefore frequently used for heat-resistant foundations, particularly when crushed firebrick is difficult to obtain. Brick crushed for aggregate should not be too soft-burned or friable and should be free from jointing or other contamination.

The term refractory concrete is usually reserved for a mix of crushed firebrick with high-alumina cement, and it is this type which is most widely used. The upper temperature limit of the concrete depends on two main factors: (1) the proportion of cement in the mix, and (2) the alumina content of the firebrick aggregate. As the proportion of cement in the mix is lowered the fusion point of the concrete is raised. In general, therefore, "leaner" mixes have higher refractoriness. At the same time, reducing the cement content lowers the strength of the concrete and accordingly the mix decided upon must be a compromise influenced by the relative importance of strength or refractoriness. The refractoriness of the concrete also increases with the alumina content of the firebrick and when using a good quality firebrick aggregate (more than 40 percent alumina), a hot-face temperature of 1350°C. is readily withstood by mixes of the normal proportions given below.

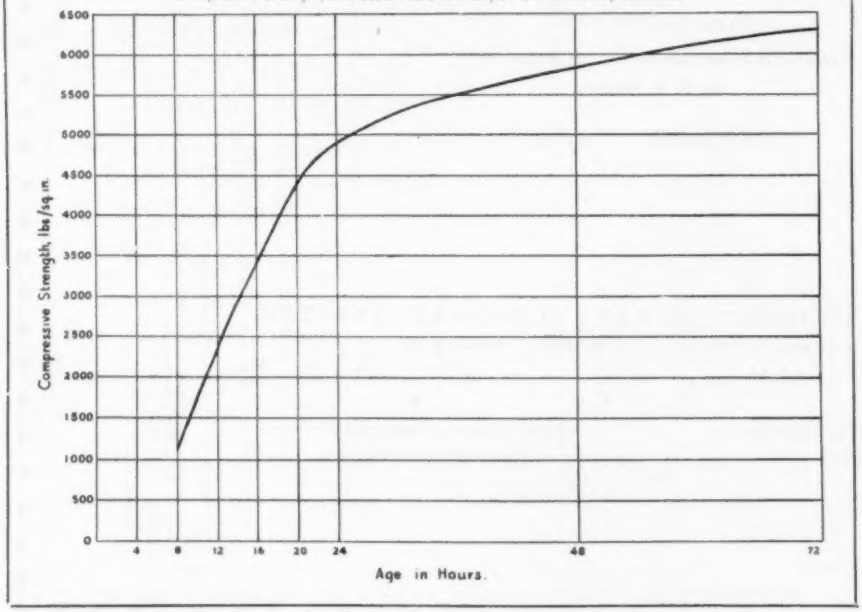
The technique of casting refractory concrete is similar to that for ordinary concrete. The crushed firebrick should be reasonably equally graded from the maximum size down to dust and may contain about 10-15 percent of fines passing the 100 mesh sieve. Customary mixes are four or five volumes crushed firebrick to one volume high-alumina cement in the case of ¾" down material, or 2½-4 volumes to one volume cement in the case of finer aggregates. Since the crushed firebrick is absorbent, it is best to soak it before mixing with the cement or else give a mixing time sufficiently prolonged (five minutes) to ensure that the aggregate will not absorb too much water from the mix when it has been consolidated in place. Refractory concrete sets in about two-four hours and then rapidly gains strength as is shown in Fig II. It is ready for any service after 24 hours but should preferably be taken up to temperature fairly slowly on the first occasion since a considerable amount of water must be driven off and sudden steam formation might be harmful. A proportion of the high cold strength is lost on heating but the residual strength is usually more than sufficient for all refractory purposes. The chief characteristics of the material are:

(1.) High resistance to thermal shock.

(2.) Volume stability. There is no appreciable shrinkage on hardening and the dimensions at the working temperature are almost exactly the same as the cold cast dimensions. Moulds can therefore be made to the exact size required.

FIGURE II

Compressive strength, unfired, 8 hours to 3 days, 3:2:1 refractory concrete.



(3.) Ability to be cast in large monolithic units or in complicated special shapes.

The advantages of concrete construction can therefore be extended in many cases to the making of furnace walls, roofs, hearths, doors, burner ports or quarls, and to the lining of high temperature reaction vessels, stacks and flues.

The bulk density of refractory concrete is about 100-120 lbs. per cubic foot, which is lower than that of the firebrick used for aggregate. This lower density results in a lower thermal conductivity for the concrete construction. Whereas the average thermal conductivity of aluminous firebrick (under the usual working conditions) is about 9-10 Btu/ft²/°F./inch, an average figure for refractory concrete at temperatures from 500°C.-1000°C. (950°-1850°F.) would be 7-7.5 Btu/ft²/°F./inch.

It will be seen from Table I that for temperatures above 1350°C. the use of refractory aggregates such as sillimanite and chrome is required, and consequently these special refractory concretes, which are made and used in the same way, have not yet been employed so extensively as the ordinary refractory concrete made with crushed firebrick.

For the user who does not wish to prepare or buy his own aggregate, many proprietary ready-mixed "castables" are available. Sold under a variety of names, these consist essentially of high-alumina cement and brushed firebrick, or other refractory material) already correctly proportioned in the dry state. Only the addition of water is necessary to produce a refractory concrete mix and the makers provide full working instructions. Some of the special refractory concretes for temperatures above 1350°C., e.g. those containing chrome or chrome-magnesia, are also obtainable as ready-mixed castables.

In many situations where high-alumina cement has been employed in refineries it is advantageous to combine adequate heat resistance with a high degree of thermal insulation. Both these requirements are met by using a mix of high-alumina cement and a lightweight aggregate. The concretes so produced are employed mainly for thermal insulation at higher temperatures and may be classified separately as "insulating concretes." They can be regarded as lightweight refractory concretes having greater insulating properties but lower strength and abrasion resistance. Most types have a lower fusion point than refractory concrete and can be used only to about 1000°C. (1850°F.).

There are many kinds of lightweight aggregate and information about their respective characteristics is not widely distributed. In view of their importance in oil refinery work, the most common types of insulating aggregates, and the properties of the high-alumina cement concretes made from them, deserve some attention.

The four most common lightweight aggregates for high temperature insulating concretes are:

(1) Calcined diatomite (hot-face temperature limit of concrete 1000° C.)

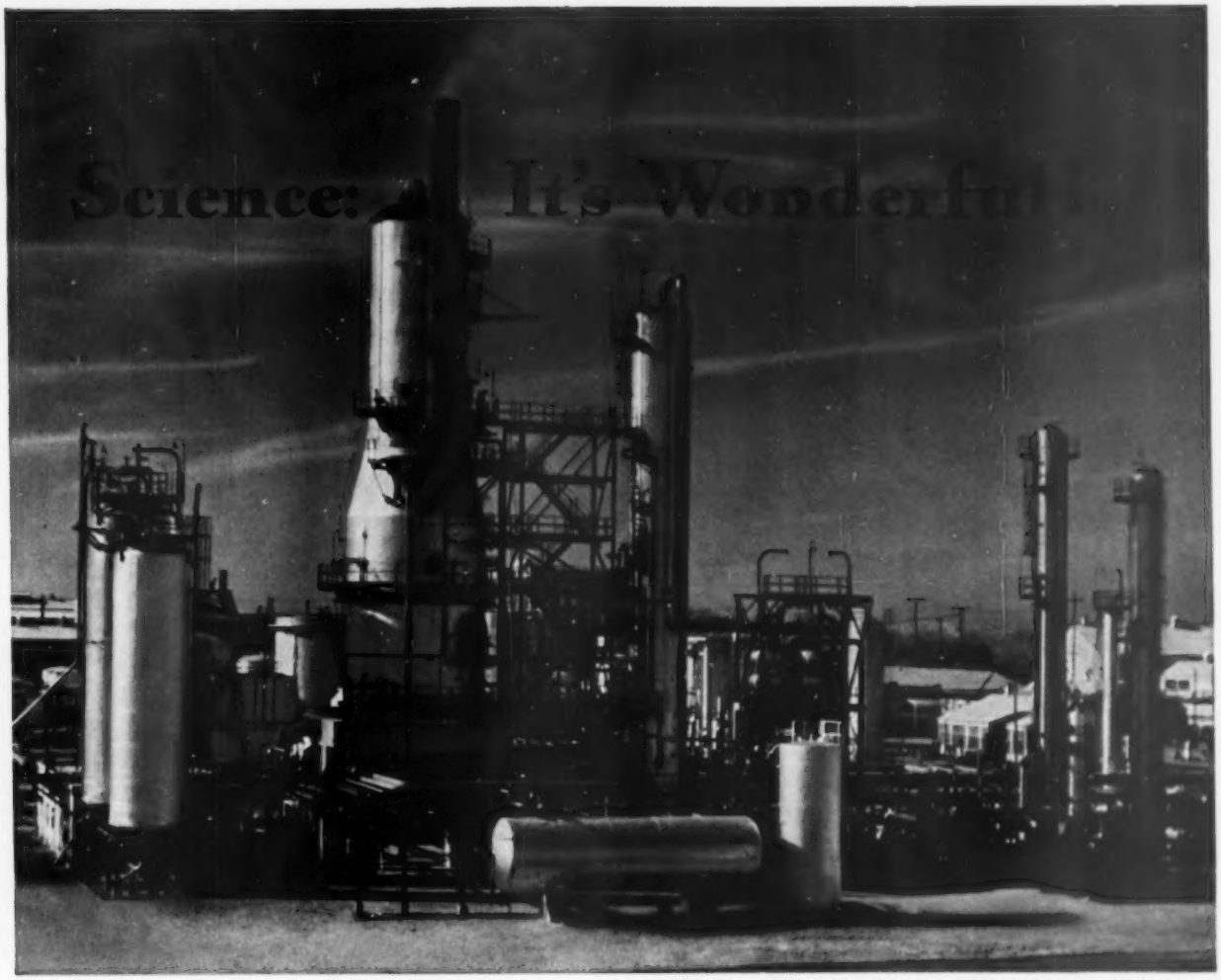
(2) Vermiculite (hot-face temperature limit of concrete 1000°C.)

(3) Expanded (bloated) clay or shale (hot-face temperature limit of concrete 1000°-1200°C.)

(4) Porous fireclay (hot-face temperature limit of concrete 1350°C.)

All the above types of aggregate are now available in England and castable mixes containing the aggregate and cement in the correct proportions can be obtained for insulating concretes (1), (2) and (4).

(1) In diatomite insulating concrete the aggregate is obtainable in a form suitable for use with high-alumina cement under various proprietary names (e.g. Fosalsil No. 1, Silocel C³). Alternatively, diatomite insulating bricks may be crushed by the user to produce an aggregate of the required grading. The customary mix consists of four volumes of aggregate (graded from 3/16" to dust) and one volume of high-alumina cement. Since this aggregate is highly porous it is desirable to pre-soak before incorporating the cement. This is, of course, not possible in the case of a ready-mixed proprietary castable and therefore adequate mixing time should be allowed. The density of the placed concrete, after drying out, is about 75 lbs./cu. ft. and this is further reduced to about 60 lbs./cu. ft. at the operating temperature. Values for the thermal conductivity of this concrete have been given as follows:



Photograph by Anthony Linck at Cities Service Refinery, Ponca City, Oklahoma

CHANGE, SPURRED on by science, is the immutable law. A company that clings to old-fashioned ways is doomed . . . especially in the oil business, where hundreds of companies are outdoing each other to produce and market better products and services—and more economically.

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Change, aided and abetted by science, has been "top of the agenda" at Cities Service. For example, at the Ponca City refinery, you will find a new orthoflow cat-cracking unit, an expanded crude topping unit, a new machine shop, a new vacuum unit for feed stock, and new laboratories.

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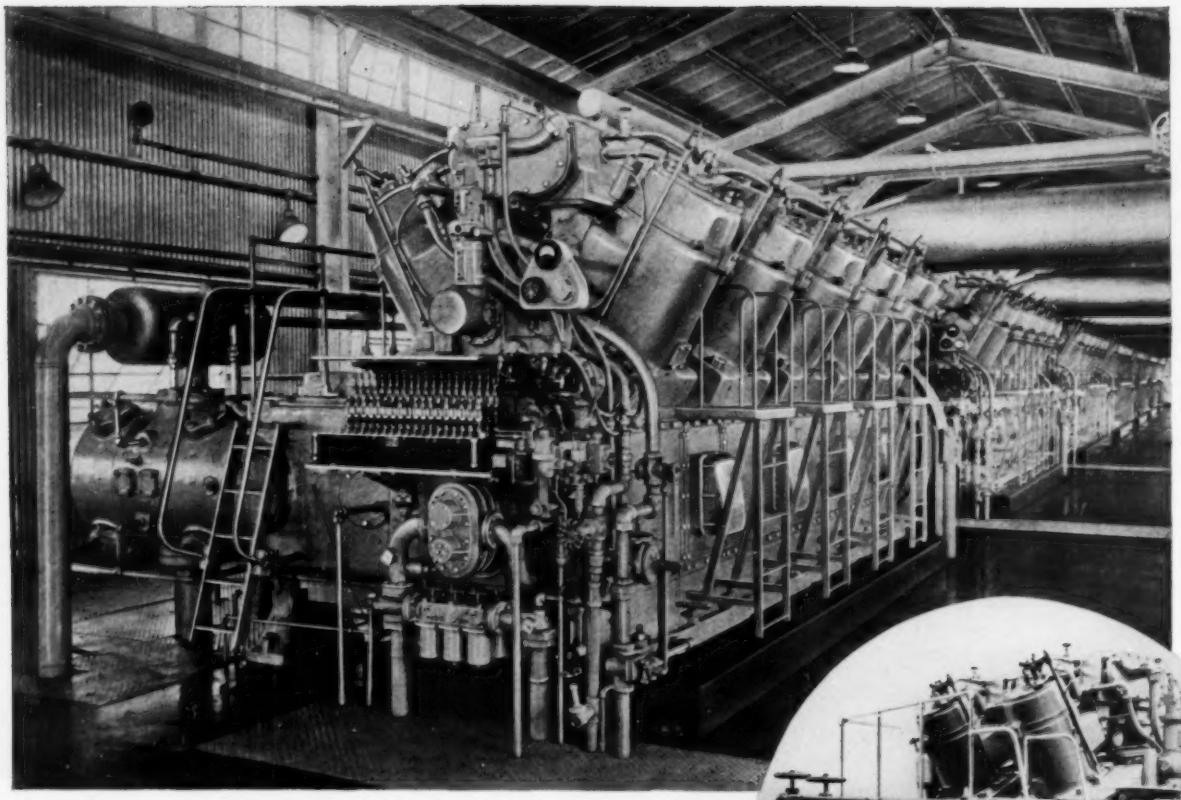
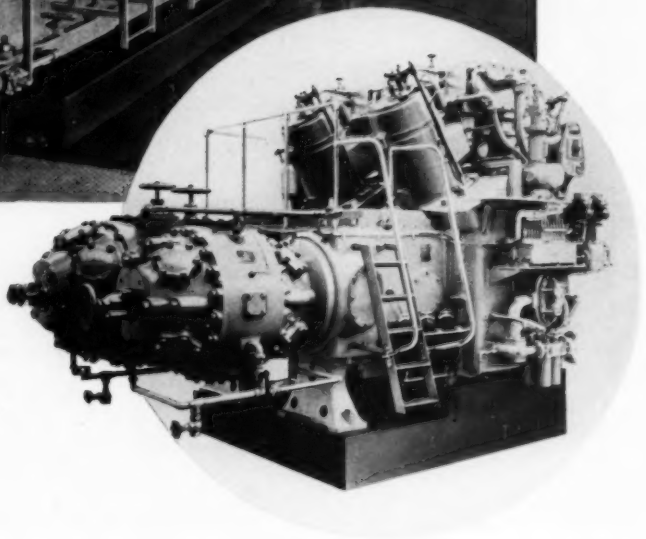


Seven supercharged GMV 10-cylinder compressors rated 1,350 h.p. in a cycling and processing plant operated by the Shell Oil Company.



A GMV 4-cylinder compressor 440 h.p. Two of these together with two 6-cylinder 660 h.p. compressors have been ordered for each of the Anglo-Iranian Oil Companies' refineries at Llandarcy, Grangemouth, and Isle of Grain, Kent.

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London Office : 9, Whitehall, S.W.1.

L. 213

Hot-face	Cold-face	'K' Value (Btu/ft²/hr/°F/inch)
200°C. (392°F.)	30°C. (86°F.)	1.5
400°C. (752°F.)	30°C. "	1.7
800°C. (1472°F.)	30°C. "	1.9
1000°C. (1832°F.)	30°C. "	2.0

For normal operating conditions where the cold face may be much higher than the above figure, it is usual to take an average 'K' value of about 2.0 Btu/ft²/hr/°F/inch.

High structural strength is not usually required or even obtainable with insulating concrete, but the mix given above has an extremely useful cast strength of 2000-2500 lbs./sq. in. while the fired strength is in the region of 500-1000 lbs./sq. in. A lower proportion of cement in the mix (e.g. a 6:1 or even 8:1 mix) will often give sufficient strength for the required situation and, at the same time, a higher insulating value. Conversely, a mix richer than 4:1 might occasionally be employed where higher mechanical strength was necessary, but the 'K' values would then be somewhat greater than those given above. Several castable mixes consisting essentially of calcined diatomite and high-alumina cement already combined in the correct proportion can be bought. The concrete made by mixing with water according to the makers' recommendations has similar characteristics to that already described.

(2) Vermiculite is a complex silicate with a mica structure which is mined chiefly in South Africa and the United States. When flakes of it are suddenly heated to about 800°C. (1470°F.) they expand or "exfoliate" into granules like concertinas which have a volume of 10-15 times greater than that of the original flakes and which have a loose bulk density of 3-10 lbs./cu.ft. according to size. This exfoliated vermiculite (which may also be marketed under proprietary names, e.g. Zonotherm, MetaMica, etc.) is a very suitable aggregate for use with high-alumina cement to make an insulating concrete which can withstand hot-face temperatures up to about 1000°C. (1850°F.).

Vermiculite is obtainable in several size grades but a good average mix for insulating concrete consists of four volumes vermiculite (¼"-20 mesh) to one volume high-alumina cement. The density and consequently the thermal conductivity of a vermiculite concrete depends on the grading of the aggregate, on the proportion of cement, and on the degree of compaction, but a 4:1 mix as above will normally have a density of 50-60 lbs./cu.ft. after drying out and 30-35 lbs./cu.ft. after being fired in service. The thermal conductivity is 0.75-1.5 Btu/ft²/hr/°F/inch when used as a high temperature insulating medium.

Because of the weak nature of the aggregate, no great mechanical strength can be expected from vermiculite concrete and in practice it will be found that the compressive strength after firing to temperatures up to about 900°C. (1650°F.) is 200-400 lbs./sq.in. This type of concrete is therefore usually employed as a backing-up insulation behind some denser cover such as refractory concrete.

In gauging vermiculite concrete it is sometimes recommended that a slurry of the cement and half the mixing water should first be made in the mixer. The vermiculite is then wetted with the rest of the water before being added to the mixer. Too prolonged mixing may give rise to "balling." The total amount of water should be sufficient to allow the cement paste to coat the granules evenly without running through to the bottom of the mix when placed. An alternative method used particularly when mixing by hand is to wet the aggregate with about half the water, mix in the cement, then bring up to the required consistency with the remainder of the water.

Ready-mixed castables should be turned over with the recommended proportion of water until the whole is even in color.

(3) Certain types of shale or clay, when heated to 1100°C.-1500°C. (2000°F-2700°F.) in a rotary kiln, "bloat," giving a pumice-like structure, and aggregates made in this way have been extensively employed with high-alumina cement. The upper temperature limit of the concrete depends to some extent on the refractory properties of the clay and on the temperature to which it has been fired, but it usually lies between 1000°C. and 1200°C. (1850°F.-2200°F.).

A considerable variation in the density and strength of this aggregate is possible according to the degree of "bloating." Also in some processes the finer portion of the aggregate is sized before kilning while in others the fines are produced by crushing larger particles after they have been fired. Since the passage through the kiln is usually designed to produce rounded particles with less absorbent outer skin, the amount of subsequent crushing determines how much of the inner porous structure is exposed and has a decided effect on the workability and absorption of the aggregate.

Among the American aggregates of this type are Haydite and Gravelite, and many linings in oil-refinery plant have been carried out with high-alumina cement and this expanded shale or clay aggregate. The densities of various Haydite concretes (dried but not fired) have been given as follows:

Mix (by volume)	Dried density of concrete
4:1	88 lbs./cu.ft.
5:1	83 "
6:1	79 "

The thermal conductivity of a mix of four volumes Haydite and one volume high-alumina cement is stated to be:

Mean Temperature	'K' (Btu./ft²/hr/°F./inch)
200°C. (400°F.)	3.15
320°C. (600°F.)	3.25
430°C. (800°F.)	3.4
540°C. (1000°F.)	3.47
650°C. (1200°F.)	3.55
760°C. (1400°F.)	3.57

The recommended mortar mix for brick setting or for rendering consists of 2½ volumes Haydite (R. A. Grade), 1-5 volumes plastic fireclay, and one volume high-alumina cement.

Leca is a similar type of aggregate which has recently become available. Although basically the same as Haydite, its bulk density is less and it appears to give concrete which, although lower in strength, has a higher insulating value than an equivalent Haydite mix. It is sold in three grades: ¾"-⅛", ½"-⅛", and ⅛" down to dust. Apart from the very fine material, it consists largely of rounded particles with a comparatively low absorption value. Recent tests have shown that a mix of two volumes medium Leca, two volumes fine Leca, and one volume high-alumina cement gives a concrete which weighs 70 lbs./cu ft. after drying out and about 60 lbs./cu.ft. after firing. The cold compressive strength is about 1600 lbs./sq.in. with a fired strength of 600-700 lbs./sq.in. Refractoriness-under-load tests on this mix show 5 percent subsidence at 1160°C (2120°F.), and it would therefore seem that this mix could be used safely to a hot-face temperature of at least 1150°C. (2100°F.). The thermal conductivity at working temperature is about 2.0-3.0 Btu/ft²/hr/°F/inch.

The mixing procedures recommended for vermiculite concretes are also suitable for expanded shale concretes.

(4) Most of the insulating concretes previously considered have had a hot-face temperature limit of about 1000°C. In some cases however it may be desired to retain the advantages of castable insulation although the hot-face temperature exceeds this limit. In such situations it is possible to employ concretes made from special insulating aggregates which are produced from a refractory clay or fireclay at a high temperature and by a process which renders it cellular or porous. The clay may be of the kaolin type, in which case the color of the final aggregate is white, while other refractory clays give aggregates varying in color from light buff to brown. Concretes made with this type of insulating aggregate and high-alumina cement are suitable for hot-face temperatures of about 1350°C. A typical aggregate of the kaolin type (Moler H. T.) is graded from ⅜" to dust, and the normal mix consists of six volumes aggregate to one volume high-alumina cement. The density of the concrete after placing and drying out is about 75 lbs./cu.ft. with a density in service of about 65 lbs./cu.ft. Values given for the thermal conductivity are:

Hot-Face Temperature	Cold-Face Temperature	'K' (Btu/ft²/hr/°F./inch)
446°C. (835°F.)	30°C. (86°F.)	2.16
734°C. (1353°F.)	30°C. "	2.28
946°C. (1735°F.)	30°C. "	2.37
1109°C. (2030°F.)	30°C. "	2.44

The cold strength of this concrete is 700 lbs./sq. in. which is reduced to 400-500 lbs./sq. in. on firing.

Since many varied types of high-alumina cement concrete have already been employed for corrosion resistance, for rapid-hardening, for heat resistance, or for a combination of these properties, a number of practical examples will be mentioned.

One of the major uses has been for lining reaction vessels, tanks, pipes, stacks and flues. A silica sand mortar is suitable for protection of steel shells when the temperature is below 250°C. (500°F.). Above this temperature, a heat resistant, refractory, or insulating aggregate must be used. Much of this work is done with mixes applied by a cement gun, since very good adhesion is thereby obtained. In this case a mix consisting of three volumes aggregate to one volume high-alumina cement is fairly standard. The steel shell is thoroughly cleaned (e.g. by sandblasting) and a light-gauge 2" mesh is spot-welded to it at 6" centers. Alternatively, a good key can be provided by welding small hooks to the shell. The mortar is then "gunned," taking care to avoid lamination by applying to the full thickness wherever possible. The mortar surface is sometimes brushed before it has set in order to give a smoother texture. All work should be kept wet (by periodic sprinkling) from the time of set until 24 hours after placing, as only in this way can the highest strength and endurance be obtained.

Pipes may be lined internally to protect against treatment liquors and crude oils, or they may be coated externally to prevent attack by ground waters. In the case of bubble towers and vaporizers, it has been stated that high-alumina mortar linings allow the use of ordinary carbon steel shells when alloy steels would otherwise be necessary. Linings have also been successfully used for vacuum condenser receiver drums, cracker drums, the cone section of vacuum towers, barometric condensers, fractionating towers and flash columns.

Refractory or insulating concrete is very convenient for steel stacks, and in some cases where an existing unlined stack has corroded badly, an external shell of high-alumina cement concrete has been gunned-on, using the old steel as formwork while the stack is still in service. Monolithic underground flues are easily constructed in the same material.

Reaction chambers lined with refractory concrete are in use at 425°C. (800°F.) under conditions of high pressure and in contact with solutions containing sulfurous acid and weak sulfuric acid. Haydite mortars have been employed for the internal insulation of regenerators and no doubt Leca will be similarly adopted. Owing to the lighter nature of the Leca aggregate, it may be necessary to gun a surface coat of crushed firebrick mortar when higher abrasion resistance is required.

Diatomite concrete or mortar has been utilized for lining sour water strippers and cooler boxes, while a 3:1 vermiculite mix is popular for facing tube-sheets in the oil still furnace. Vermiculite concrete, or other insulating concrete) is also used in the hearth, walls, and roof arches. A ventilated refractory concrete foundation slab gives protection from the soaking heat developed by the furnace.

Crushed firebrick concrete has many other uses —for furnace doors, for precast shapes, such as burner-blocks, for heaters and coking ovens, for floors subject to radiant heat, and for boiler baffles. A suggested use is for retaining walls around oil storage tanks since not only will this type of concrete resist the heat of any conflagration, but it may be quenched in water without suffering damage.

In conclusion it is hoped that the preceding outline of the characteristics of the many kinds of high-alumina cement concretes will indicate their versatility and will provide sufficient information to allow their use in new ways.

Maintenance Manuals

Manuals detailing practical maintenance programs to insure continuous and efficient operation of gas and diesel engines have been published by the Cooper-Bessemer Corp. Field experiences show the program to be superior to conventional methods for maintaining such equipment. One manual covers gas-diesel and diesel engines; a second manual covers gas engines. In contrast to the usual periodic 8,000-hour overall check or the progressive-type maintenance schedule, Cooper-Bessemer's manuals show how to perform continuing checks on engines while in service to accurately forecast internal conditions of the engines and anticipate operational needs.

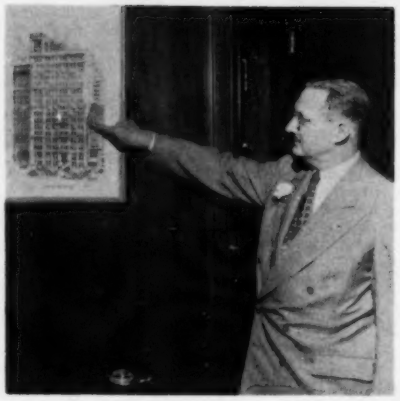
The manuals can be obtained for $2.00 a copy by writing to H. T. Watson, The Cooper-Bessemer Corp., Mount Vernon, Ohio.

Named Centrifugal Pump Section Managers

Roy Carter has been appointed manager of the volute pump section of Worthington Corp. He has been with the centrifugal pump division since 1932 and with the company since 1923. L. H. Garnar has been appointed manager of the process pump section, being transferred from the centrifugal pump division where he has served since 1930. I. J. Karassik has been appointed manager of the multi-stage pump section. He has been with Worthington since 1934 and the centrifugal pump division since 1935. He is a well known contributor to trade magazines, having written well over 300 articles.

Appoints Technical Representative

Edward R. Hayes, formerly with the research department of the Standard Oil Co. (Ind.), has joined the sales staff of the catalyst division, National Aluminate Corp. He will serve as technical representative in connection with sales of cracking catalyst to the petroleum refining industry.



Albert J. McIntosh, Socony-Vacuum Oil Company, Inc., points out office where he first worked at 26 Broadway when he joined the company 40 years ago at the age of 14. First employed as an office boy, Mr. McIntosh completed his high school and college education by attending night school. He has been the company's economist since 1937.

Gulf Builds New Blending Plant

Gulf Oil Corp. has announced completion of a new canning, drumming, and blending plant at its terminal on Ship Yard Creek, Charleston, S. C.

The new plant will blend and package one and five-quart cans as well as five-gallon cans, five-gallon pails, 55-gallon drums, 14-gallon drums, and possibly other sizes of branded motor oils and a large line of industrial oils for immediate distribution in North and South Carolina and Georgia. Other products already packaged will be received by ship and redistributed from the Charleston terminal.

Tide Water Honors Distributors

Tide Water Associated Oil Co. recently paid special tribute to its eastern distributors who have been affiliated with the oil company for 20 or more years. Sixty-four distributors, representing collective service with the company of 1,552 years, received bronze plaques for their long and loyal associations with the oil firm and their distinctive record of public service in their communities. One distributor, the F. D. Koehler Co., Inc., of Staten Island, N. Y., received a 35-year plaque.

The awards were made by Eugene F. McCabe, general sales manager, who served as toastmaster. Director and Vice President B. I. Graves, chairman of the operating committee of the company's Eastern Division, and other company officials were present.

Builds Sulfur Plant

Standard Oil and Gas Co. has announced plans for construction of a 17.7-ton sulfur recovery unit at a second West Texas gasoline plant, the North Cowden plant, near Odessa, Texas. The Girdler Corp. will design and build the plant.

Stanolind previously announced that a similar 49-ton unit was to be constructed by the Fluor Corp. at Slaughter gasoline plant near Sundown, Texas. Both North Cowden and Slaughter are operated by Stanolind for groups of owners. At the present time, the feed gas to the sulfur recovery unit at the Slaughter plant contains 16.5 percent hydrogen sulfide and the North Cowden feed gas 58 percent hydrogen sulfide. Stanolind also operates a sulfur plant in Elk Basin, Wyoming.

Study Oil Storage Needs

L. S. Wescoat, president of Pure Oil Co., has been appointed chairman of a National Petroleum Council committee to study the oil industry's needs for secondary storage, particularly on the Atlantic seaboard.

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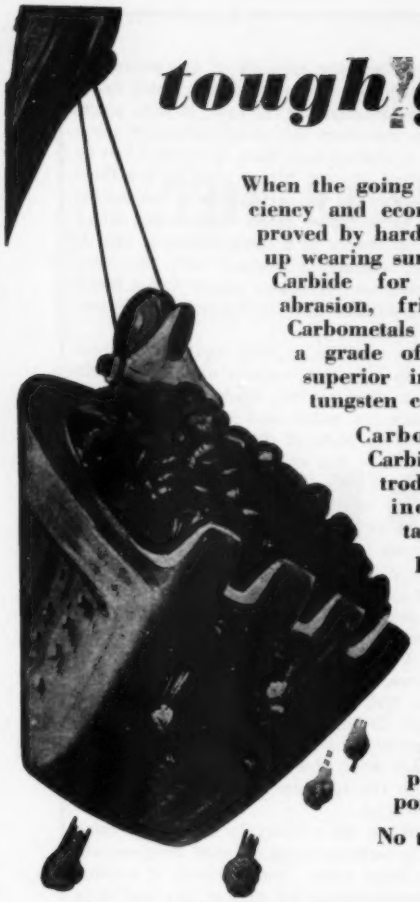
tough going



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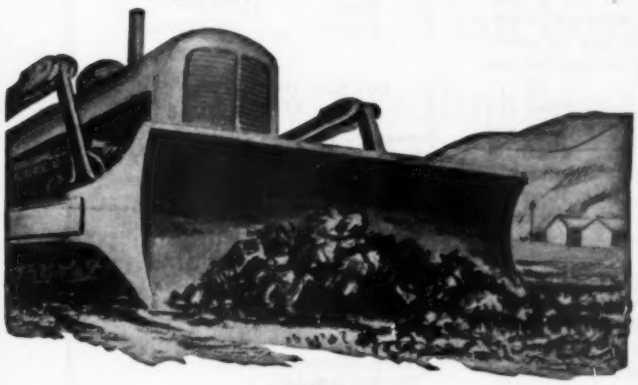

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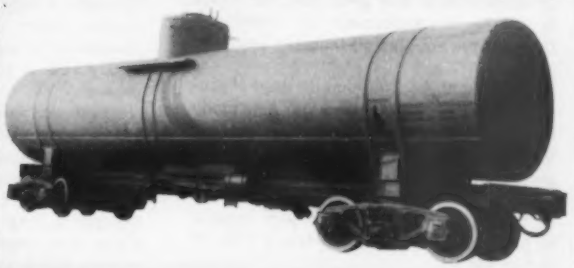

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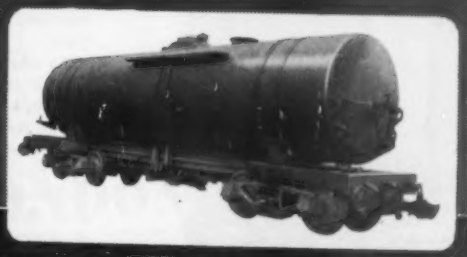

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MOTHERWELL, SCOTLAND.

Kent Refinery

(Continued from page 77)

lubricants pass on to the final clay treating plant, while the waxy extracts provide a portion of the feed stock for the catalytic cracking plant.

The clay treating plant is of the conventional hot treating, sweetening and drying type, to the design of The Lummus Co.

For the purpose of raising steam for all requirements, five Spearing boilers have been installed, each of 150,000 lbs. per hour steam capacity, working at 560 psig with steam superheated to 740°F. The process load for the refinery is 430,000 lbs. per hour. For operation of Stage I of the refinery, one boiler will be working at 200 psig for the purpose of supplying refinery steam for pumps and process steam.

Eventually, electrical power will be partly generated by the refinery and partly drawn from the grid, but for Stage I, at the commencement of operations, the required supply will be taken from the grid.

There will be four multi-stage back-pressure steam turbo alternator sets made by the English Electric Co., Ltd., two at 5,000 kw each and two at 3,000 kw each, giving an installed capacity of 16,000 kw.

The alternators are designed to operate in parallel with the 11 kv grid supply to provide the refinery electrical load of 14,500 kw.

The turbine of one 5,000 and one 3,000 kw set will exhaust at 250 psig to a battery of 12 high pressure evaporators taking water from local sources to provide process steam at 180 psig. The condensate from the evaporators will go to the boilers and the water feed to the evaporators will be treated by a lime soda base exchange treatment plant by Permutit Ltd. The remaining two sets will exhaust at 180 psig and blend with made steam from the evaporator plant for process purposes.

The generated current will be stepped down to 3.3 kv for all motors above 50 hp, to 440 volts for all motors below 50 hp, to 250 volts for lighting and to 110 volts for instruments.

The cooling water requirements for the refinery will be 4,000,000 gallons per hour and will be salt water drawn from the river Medway. For this purpose a reservoir of 16,000,000 gallons capacity has been constructed by enclosing a small bight on the foreshore by a new section of sea wall which is normally filled by the rising tide through balanced flap valves, except at neap tides when gill-type pumps of 2,000,000 gallons per hour capacity are brought into operation to insure continuity of supply. From here the water flows through a concrete canal to the main cooling water pump house about three-fourths of a mile away. The reservoir also forms a settling tank for any silt present.

There are four main water steam turbine pumps, each of 1,500,000 gals. per hour capacity at 150 foot head (60 lbs.), which will circulate water throughout the refinery, the circulation being mainly through a ring main. The used cooling water then passes to the high level separators which are of API design in principle, but are constructed of pressed steel sections lined with concrete.

These high level separators have been built at such a height that the clarified effluent can flow by gravity to the river Medway which it enters about three-fourths of a mile downstream from the intake to the reservoir. The conduit for this water will be a closed one of steel concrete pipes. Process water will be obtained from local sources, and for steam raising purposes will be evaporated and conditioned.

The plant will have special stores and workshops where refinery maintenance and repairs will be carried out. The combined stores and workshops building will have an area of over 52,000 sq. ft. and is fully equipped with modern machine tools, overhead traveling cranes and welding plant.

As mentioned previously, crude oil storage for six weeks refinery requirements is contemplated, and in addition, storage for six weeks make of white oil products and eight weeks of black oil products, but this may be changed, partly to accord with requirements and partly because to date steel shortage has curtailed the provision of optimium capacities.

The sizes of the individual storage tanks will in some cases be determined by the load carrying capacity of the ground on which they are to be erected, which varies considerably over the area, in some places the maximum safe height being 24 feet.

A construction camp to house 1,700 laborers is used during erection for those members of the personnel who live too far away to travel daily. This camp, which is in charge of a camp manager, has its own cinema, a canteen with the usual amenities for indoor games and a building suitable for the holding of religious services.

In addition, a fully equipped canteen is in operation, capable of feeding 1,200 men at a sitting, while a canteen van takes tea, cakes and sandwiches to the outlying parts of the site. At peak construction the employees on site number about 7,500.

The medical aid post is open during working hours and has on duty two nurses, with an ambulance and driver, while a qualified medical man is always on call. When refinery operations start, a permanent medical aid post with professional staff in attendance will be open.

A complete fire brigade with two engines, foam equipment and other apparatus will be permanently staffed and on duty 24 hours each day. To assist in its operations, a special high pressure water main solely for fire fighting, and fitted with the requisite stand pipes, has been installed.

When the refinery is in full operation it is estimated that the staff required will be about 1,200. The provision of housing accommodation for part of this staff is in the hands of the local authorities in conjunction with the Anglo-Iranian Oil Co.

It is estimated that the following amounts of material have been used in the building of the refinery:

Steel	112,000 tons
Cement	30,000 tons
Bricks	17,000,000
Timber	600,000 cu. ft.

CONTRACTORS AT KENT OIL REFINERY

Managing Agents:
E. B. Badger & Sons (Gt. Britain), Ltd.

Civil Engineering Consultants:
Rendel, Palmer & Tritton

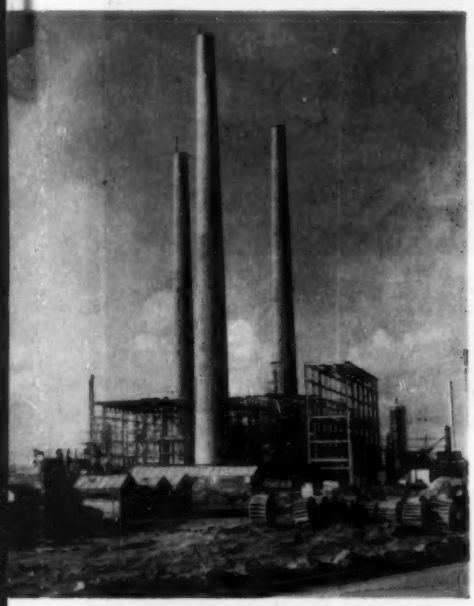
Steam & Power Consultants:
Ewbank & Partners

Main Civil Engineering Contractors:
Sir Robert McAlpine

Mechanical Engineering Contractors:
E. B. Badger & Sons (G.B.), Ltd.
Costain-John Brown, Ltd.
George Wimpey & Co., Ltd.
Matthew Hall Ltd.
Kellogg International Corp.

Tank Supply & Erection:
Motherwell Bridge & Engineering Co., Ltd.

Process Plant Contractors:
E. B. Badger & Sons (G.B.) Ltd.
Kellogg International Corp.
The Lummus Co., Ltd.
Foster Wheeler, Ltd.
Power Gas Corp.



Power plant for Kent refinery.

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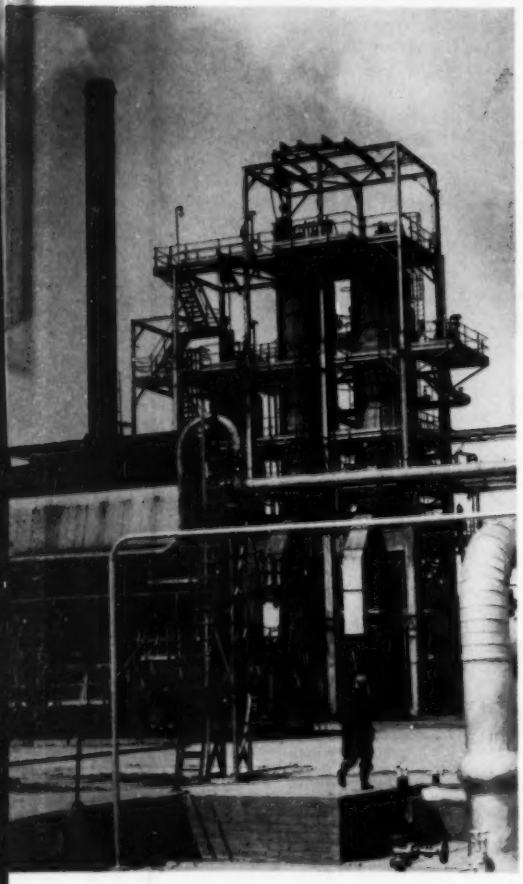
A. D. Troye, right, of Standard-Vacuum Refining Co. of South Africa (Pty.) Ltd., explains a model of the company's proposed new refinery to the mayor of Durban and other guests at the recent foundation stone ceremonies.

Below, phosphoric acid unit at Anglo-Iranian Oil Company's Grangemouth refinery.



Refining a World-Wide Industry

(Continued from page 93)

600 b/d capacity engineered by Foster Wheeler.

Australia is looking forward to a large expansion of petroleum treating facilities through construction projects of a number of companies. Anglo Iranian Oil Co. has announced its decision to establish a refinery of 60,000 b/d at Kuwinana near Freemantle in Western Australia. It will be equipped with atmospheric and vacuum distillation units and a catalytic cracking plant and is estimated to require an investment of £40,000,000.

Australian Shell has projected a new refinery of 26,000 b/d at Geelong together with lube oil and bitumen plants at an estimated cost of $22 million.

Standard Vacuum is preparing to erect a refinery of 20,000 b/d at Altona, Australia, to be completed in 1955 and to require an investment calculated at $30 million. Caltex is contemplating a plant of 22,000 b/d at Sydney to cost $56 million and to be ready for operation in 1955.

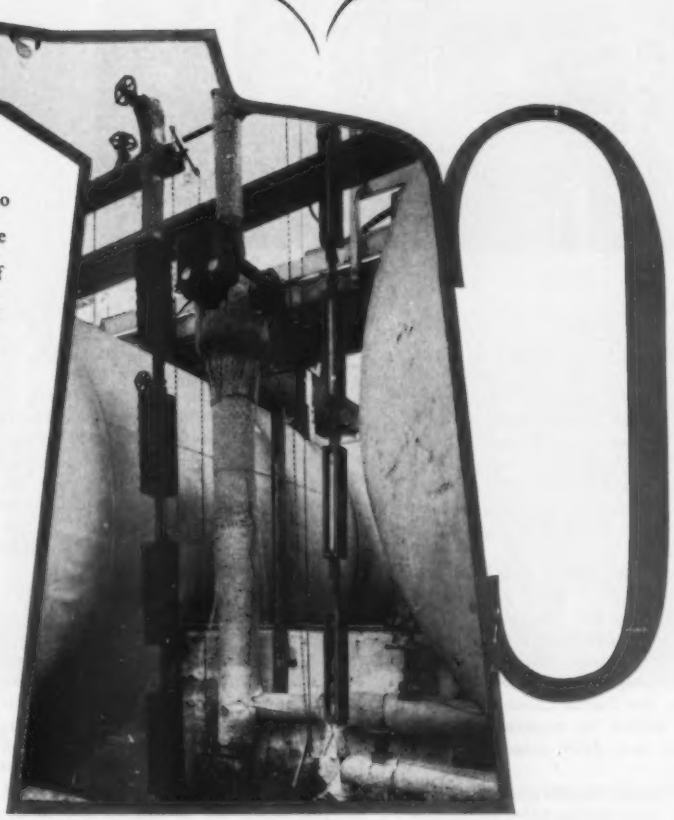
Bataafsche Petroleum is engaged in enlarging the capacity of its refineries at Pladjoe, Sumatra and Balikpapan, Borneo to 71,000 and 44,000 barrels respectively, the work to be completed within the coming year. Caltex is discussing with the Philippine government its project for a refinery of 13,000 b/d to be located near Manila and to involve the expenditure of $30 million.

With release of the controls maintained during the occupation period in Japan, private companies have the opportunity to develop better facilities. By arrangement between Standard Vacuum and Toa Nenryo Kogyo, the refineries of the latter company at Wakauma are being enlarged by the installation of propane, dewaxing and phenol extraction units. Through similar agreements, Caltex has advanced funds to Nippon Petroleum Refining Co. and the Koa Oil Co. for improvement of certain of their refineries.

In the Western Hemisphere, the greatest amount of activity naturally has been among oil companies of the United States, but there have been many important developments in other countries both in North and South America. This has been marked by the case of Canada where rapid field development and now the opening of outlets both to east and west have stimulated refinery construction. Several large plants have gone into operation since the first of the current year. Among these have been the ultra-modern refinery of Canadian Oil Refineries at Froomfield, the Edmonton plant of McColl Frontenac, formally opened in June, and the enlargement of British American's Moose Jaw refinery with construction by Tears Engineers.

In addition to these, work has been started or is shortly to begin on projects on the Pacific Coast brought to activity by the building of the Trans Mountain pipe line and others in the Prairie Provinces or further east. Among the latter a notable addition to the Dominion's petroleum treating facilities will be the re-

Klinger Gauges
in action



Richard Klinger Ltd., who originated the Reflex Gauge, are specialists in the manufacture of all types of level gauges for the Oil Industry. Special examples include Steam-heated Gauges for viscous fluids, Cooled Gauges for liquefied gases, Non-Frosting Gauges for cold liquid, Inter-Surface Level Gauges, "S" Type Reflex Gauges for extra high pressures, etc., etc. Illustration shows combined Reflex and Double-Plate Gauges installed at the Scottish Oils Refinery at Grangemouth.

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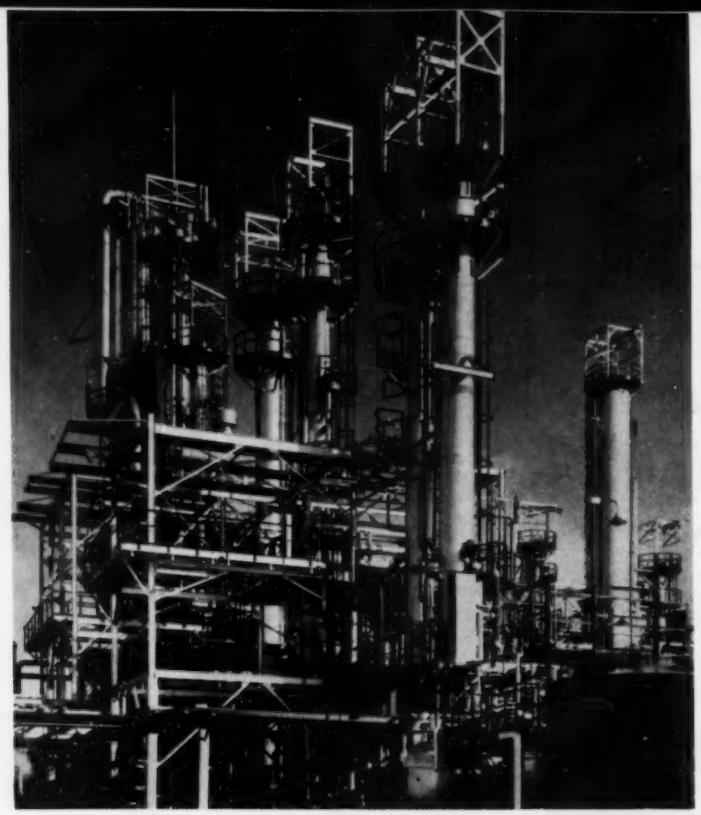


New refinery being built by Foster Wheeler for McColl Frontenac at Edmonton, Alberta.

finery of Sun Oil Co. at Sarnia on which work is just beginning. This plant, which will have a daily capacity of between 10,000 and 15,000 barrels, will be built by Catalytic Construction Co. and will be equipped with combination topping, vacuum distillation, Houdriflow catalytic cracking and catalytic reforming units. It is planned for completion in the first half of 1953.

At Sarnia, Imperial Oil Ltd. is enlarging its refinery to a daily capacity of 71,000 barrels under the engineering guidance of Canadian Kellogg. At Regina, Saskatchewan, Imperial will enlarge its refinery in a program to be completed in 1954 and on the Pacific Coast it will invest $13.5 million in expansion of its Ioco refinery to a daily capacity of 10,000 barrels.[1]

Petroleos Mexicanos, government owned oil company, has projects under consideration for half a dozen refineries in different parts of Mexico, but no specifications have been issued as yet. One undertaking that is going forward is the enlargement of the Salamanca refinery by incorporation of a lube oil and paraffin unit under supervision of Arthur G. McKee Co. Another is a desulfurization unit at Ciudad Madero under license from Perco with construction by McKee-Phillips.

On the island of Trinidad, Foster Wheeler Co. is completing an expansion program that includes installation of a 25,000 b/d thermal cracking unit, a 15,000 b/d fluid catalytic cracker and a 10,000 b/d naphtha reforming unit.

Expansion of the refining capacity of Shell's great Cardon plant in Venezuela to a daily throughput of 115,000 barrels is a notable development in the oil industry of that country. Venezuela, long the world's foremost exporter of crude and in recent years an exporter of refined products in increasing quantities, became a potential exporter of lubricating oils in mid-June, when Minister of Mines & Hydrocarbons Santiago Vera pushed a switch setting in motion the new $25 million lube plant at Shell's Punta Cardon refinery. The new installation comprises units for high-vacuum distillation, propane de-asphalting, furfural extraction, MEK dewaxing, fuller's earth treating and packaging. Production will be on the order of 1,700 barrels of lubricants per day as against a total domestic consumption in Venezuela of about 750 barrels daily. The Minister in his inauguration speech spoke of the new plant's contribution to "one of Venezuela's most deeply felt aspirations."

The high-vacuum unit, which is said to be one of the biggest in the world outside of the United States, has a capacity of 2,300 metric tons a day. Products of the vacuum still are then passed as fuel to other operations of the refinery.

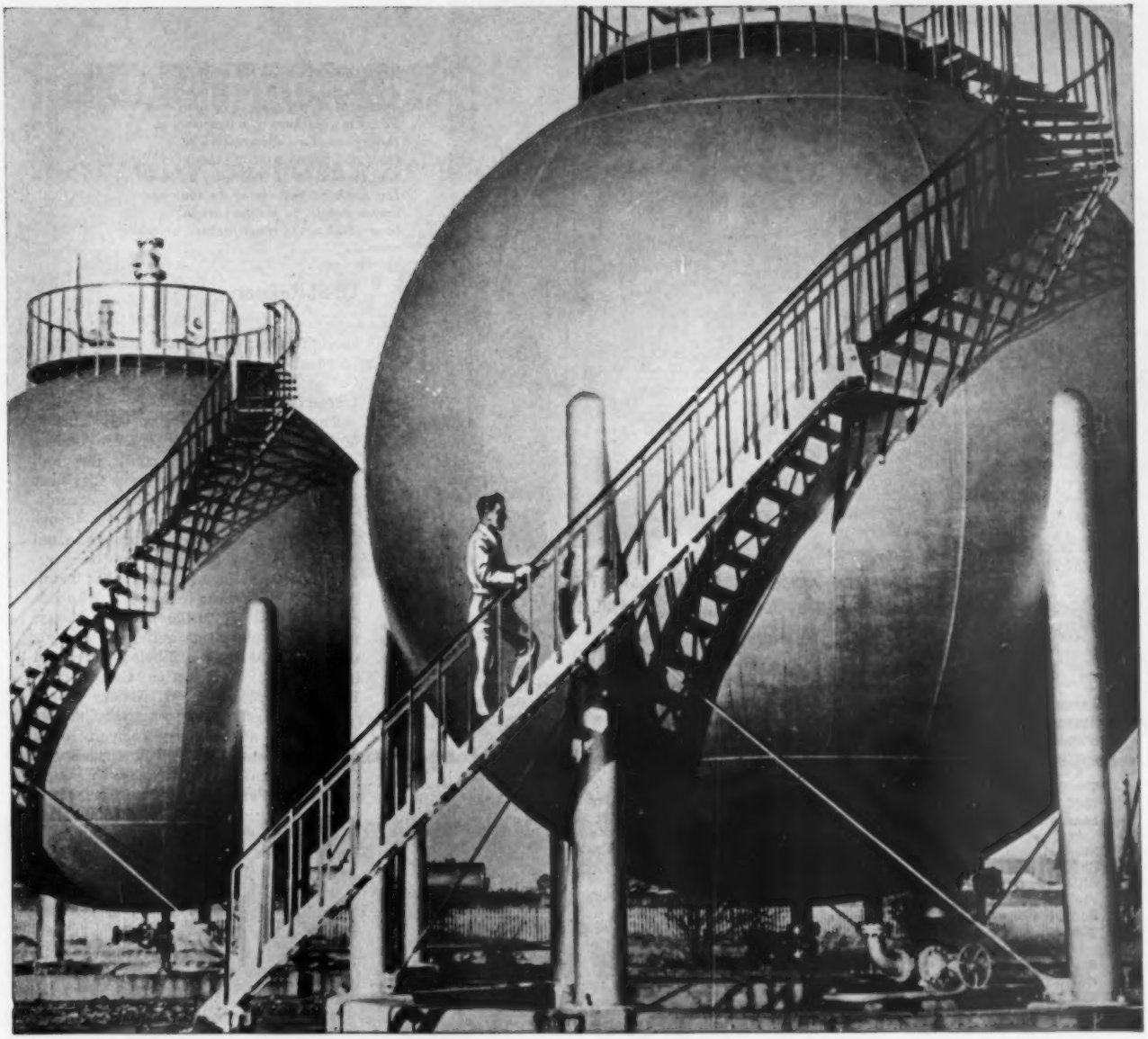
The propane is extracted by distillation and the residue moved to the third plant, where it is mixed with furfural to extract the resins and gummy constituents. The oils are dewaxed with methyl ethyl ketone and filtered mechanically before clay contacting for color. Enlargement of crude capacity is under way and due for completion in 1953. In the San Rogue field in Anzoategui, Phillips Oil Co. has just brought to completion a refinery and wax plant, the latter designed to produce two million pounds of wax per year. Construction was by the Pritchard Co. Addition of other processing equipment is planned for later installation. Revamping of the Jusepin refinery of Creole Petroleum is being carried on under the direction of C. F. Braun Co. Richmond Petroleum Co. has under consideration the construction of a new refinery in the Bajo Grande district.

Several important refinery developments are under way in Brazil. They include enlargement of the plant of the National Petroleum Council at Mataripe, and installation of a 5,000 b/d catalytic polymerization unit at Salvador, both projects supervised by Pan-American Kellogg. At Cubatao, Sao Paulo, a 45,000 b/d refinery is under construction for the Council with engineering by Pan American Hydrocarbon Research and the McKee Co. Erection of a plant of 10,000 b/d capacity in the Federal District has been authorized and construction is being directed by Foster Wheeler. At Capuavas in Sao Paulo, a 25,000-barrel refinery with thermal cracking unit is in course of erection. A proposal for a 20,000-barrel refinery at Niteroy has been put forward by Brazilian capitalists and is awaiting official authorization. At the Ipiranga refinery in Rio Grande, a 2,000 barrel thermal cracker is being installed by Foster Wheeler.

Enlargement of the YPF plant at La Plata, Argentina, including the installation of crude topping and gasoline treating units, has raised throughput capacity to 85,000 b/d. The engineering direction is by Houdry with installation in charge of Catalytic Construction Co. A new refinery at Buenos Aires is to be built by the YPF group, designed by Kellogg and having a daily capacity of 28,000 barrels. A lube oil unit is planned for Diadema refinery in Buenos Aires.

In Chile a refinery of Empresa Nacional de Petroles at Concon of 20,000 barrels daily capacity has been constructed by Pan-American Kellogg and is due for completion this year. Another refinery of 14,000 barrels is planned for erection near Valparaiso by Corporacion de Fomento do la Produccion. In Bolivia YPFB, under engineering direction of Foster Wheeler, has installed an additional unit in its Sucre refinery. In Colombia, International Petroleum is modernizing the refinery at Barranca Bermeja at a cost of $25 million under its agreement with the Colombia government, thereby raising daily capacity to 35,000 b/d.

[1] For a detailed description of new and projected Canadian plants see WORLD PETROLEUM, May 1952.



GLOBAL OPERATIONS

Symbolic of Anglo-Iranian's global operations are these Hortonspheres in the Company's refinery at Grangemouth, Scotland. By 1953 the throughput of Anglo-Iranian's four refineries in the United Kingdom will be over 200,000 barrels a day. This will increase the country's total refining capacity to some 520,000 barrels a day, to which Anglo-Iranian's throughput will be the largest single contribution.

In Australia, plans are going ahead for the construction of the largest refinery in that continent. Throughout their existing overseas refineries, Anglo-Iranian and its associated companies are rapidly increasing throughput to meet the world's demand for petroleum products.

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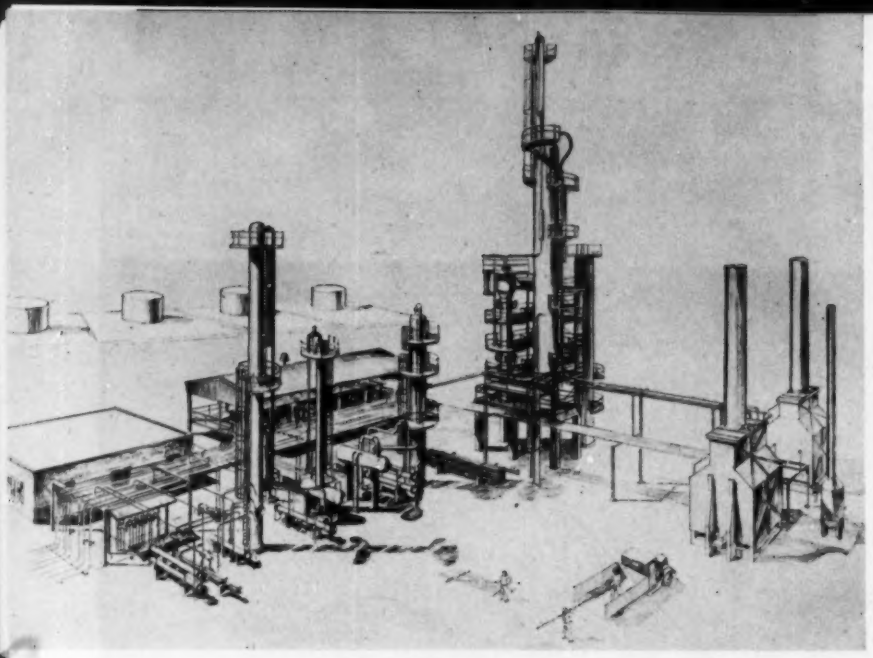

Artist's drawing of the world's first fluid hydroformer being built by the M. W. Kellogg Co. for Pan-Am Southern Corporation at Destrehan, La. Completion of the 2,000-barrel unit is scheduled for August. The unit may be used for naphtha reforming to improve octane levels, to produce avgas base stock or to manufacture aromatics.

CERTIFICATES OF ACCELERATED TAX AMORTIZATION RECOMMENDED BY PAD THROUGH APRIL 1952

Large Refiners	Crude Oil Topping (Capacity Expansion in Barrels per day)	Cat Cracking (Capacity Expansion in Barrels per day)
Standard Oil Co. (N. J.)	105,605	102,200
Standard Oil Co. (Ind.)	65,000	60,000
Socony-Vacuum Oil Co., Inc.	47,000	33,000
The Texas Co.	54,000	5,600
Gulf Oil Corp.	93,740	107,000
Standard Oil Co. of Calif.	54,700	37,500
Sinclair Refining Co.	62,000	58,000
Shell Oil Co.	80,000	52,000
Cities Service Oil Co.	52,450	20,820
Phillips Petroleum Co.	68,440	47,200
Sun Oil Co.	11,000	.....
Tide Water Associated Oil Co.	4,000	.....
Atlantic Refining Co.	60,000	31,500
Union Oil Co. of Calif.	27,000	28,500
The Pure Oil Co.	12,100	28,000
Standard Oil Co. (Ohio)	76,500	27,400
Continental Oil Co.	28,500	17,000
Ashland Oil & Refining Co.	26,500	21,100
Richfield Oil Corp.	7,725	21,000
Total large refiners	936,260	697,820
Intermediate Refiners		
Aurora Gasoline Co.	16,000	2,000
The Bay Petroleum Corp.	2,000	8,000
Cooperative Refinery Assoc.	3,800	3,400
Crown Central Petroleum Corp.	2,350	2,400
Globe Oil & Refining Co.	10,000	3,500
Lion Oil Co.	5,000	10,000
Ohio Oil Co.	10,000	5,000
Petco Corp.	4,300	10,000
Republic Oil Refining Co.	30,000	.....
Southwestern Oil & Refining Co.	15,300	5,000
Sunray Oil Corp.	25,000	9,000
Taylor Refining Co.	20,500	8,000
Texas City Refining Co., Inc.	.....	8,000
Total intermediate refiners	144,250	74 300
Small Refiners		
American Liberty Oil Co.	5,000	5,000
Bell Oil & Gas Co.	.....	5,000

Small Refiners	Crude Oil Topping (Capacity Expansion in Barrels per day)	Cat Cracking (Capacity Expansion in Barrels per day)
Ben Hur Ref.	6,800	6,000
Caminol Co.	1,500	.....
Cosden Petroleum Corp.	4,000	.....
Derby Oil Co.	5,000	8,000
Douglas Oil Co.	1,800	.....
El Dorado Refining Co.	3,450	5,000
Elk Refining Co.	1,470	.....
Famariss Oil & Ref. Co.	5,000	.....
Farmers Union Central Exchange	3,140	5,000
Fletcher Oil Co.	1,356	.....
Fulton & Olmstead	10,000	4,650
Gilcrease Oil Co.	6 000	3,000
Hancock Oil Co. of Calif.	16,066	12,000
Inland Refining Co.	.....	700
Johnson Oil Supply Co.	2,500	1,500
Kanotex Ref. Co.	5,050	5,000
Lakeside Ref. Co.	2,000	.....
Leonard Refineries, Inc.	10,000	3,000
Levelland Ref. Co.	.....	3,000
Louisville Ref. Co.	.....	6,000
M.F.A. Oil Co.	2,000	2,000
McMurrey Pet. Corp.	3,000	4,000
Mercury Oil Ref. Co.	5,900	3,000
Mid-West Refineries, Inc.	6,200	.....
Mohawk Pet. Corp.	8,000	6,800
Monarch Ref. Co.	.....	5,000
New Mexico Asphalt & Ref. Co.	3,000	6,000
Northwestern Ref. Co.	25,000	3,000
Old Dutch Ref. Co.	8,000	7,000
Panhandle Prod. & Ref. Co.	3 250	.....
Petroleum Specialties	1,500	.....
Pontiac Ref. Corp.	.....	5,000
Premier Petroleum Co.	6,000	4,000
Rado Refining Co.	1,500	.....
Rado Refining Co.	4,000	3,025
Rothschild Oil Co.	.....	6,000
The Shamrock Oil & Gas Corp.	2,500	6,000
Superior Refinery Owners	6,000	1,000
Vickers Petroleum Co.	5,000	4,000
Western Oil & Fuel Co.	10,000	3,000
Western States Ref. Co.	3.000	2,000
Wood River Oil & Ref. Co.	15,000	7,000
Total small refiners	208,982	150,675
Grand total all companies	1,289,492	922,795

U. S. Refiners

(Continued from page 105)

catalytic unit and a UOP Platformer to be completed in 1953. McMurrey Refining Co. will add a 5,000 barrel catalytic reformer at Tyler in 1953.

The Lummus Co. is to construct a 30,000-barrel catalytic cracker and a catalytic polymerization unit for Pan American Refining Co. at Texas City next year. Republic Refining Co. has commissioned Universal Oil Products Co. to undertake a general expansion and to install a Platformer at its Texas City refinery. Standard Oil Company of Texas is installing in its El Paso refinery a catalytic cracking unit of 10,400 barrel capacity, vacuum and alkylation units, and a vapor recovery plant, the work being performed by Catalytic Construction Co., Houdry Process Corp., and M. W. Kellogg Co.

Sunray Oil Co. has announced plans for erection by a subsidiary company of a new refinery of 25,000 b/d capacity at Corpus Christi, engineered by The Lummus Co. Gilmore Refineries, Inc. plans construction in 1953 of a 50,000-barrel refinery at Odessa, Texas. Panhandle Producing and Refining Co. is installing a new crude unit of 8,000-barrel capacity at Wichita Falls, Texas.

Phillips Petroleum Co. enlarged its daily throughput by 31,000 barrels through improvements installed during 1951, and has increased the output of high grade alkylate at its Phillips and Sweeny, Texas refineries. Special fuels for jet propulsion engines are being manufactured at five of the company's refineries. The company is adding to its extensive natural gasoline operations by the erection of gasoline plants in the Spraberry trend area of West Texas and now operates 25 wholly owned and three jointly owned plants with interests in seven others.

In the Mid-Continent area, Continental Oil Co. has undertaken a $7,500,000 development program at Ponca City, Okla. This includes installation of continuous contact coking equipment, a lubricating oil additives plant, and enlargement of the power plant. Also at Ponca City, an Orthoflow catalytic cracking unit has been installed in the refinery of Cities Service Oil Co. Born Engineering Co. is guiding the installation of a crude unit of 15,000 b/d capacity for Tide Water Associated Oil Co., Drumright, Okla. At Duncan, Okla., Refinery Engineering Co. is rehabilitating Sunray's alkylation plant.

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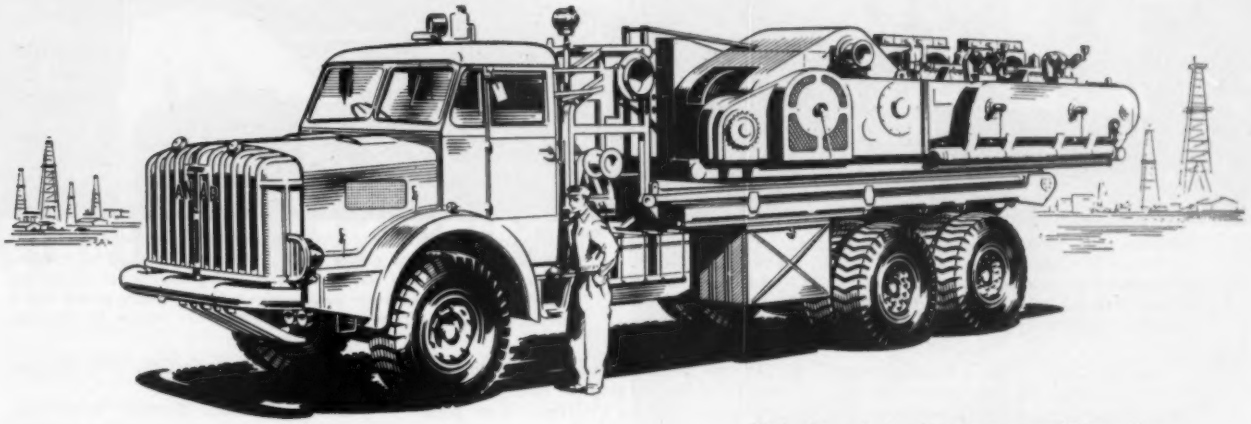

"Mighty Antar" 25 ton self loading oilfield truck. One of several shipped to Sarawak and Venezuela for Shell.

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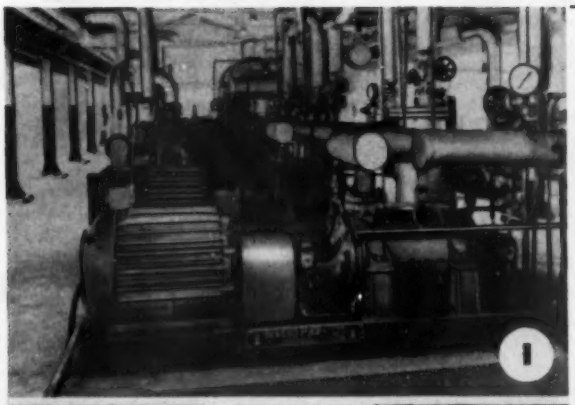

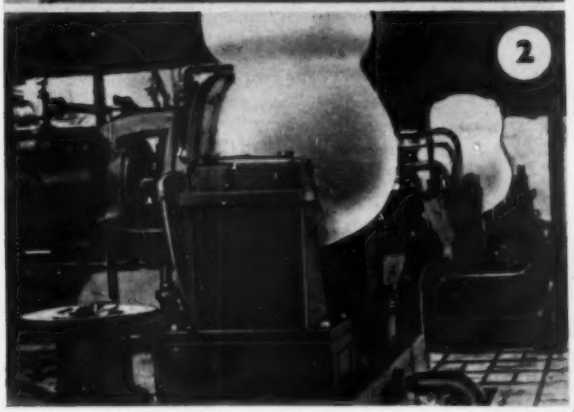

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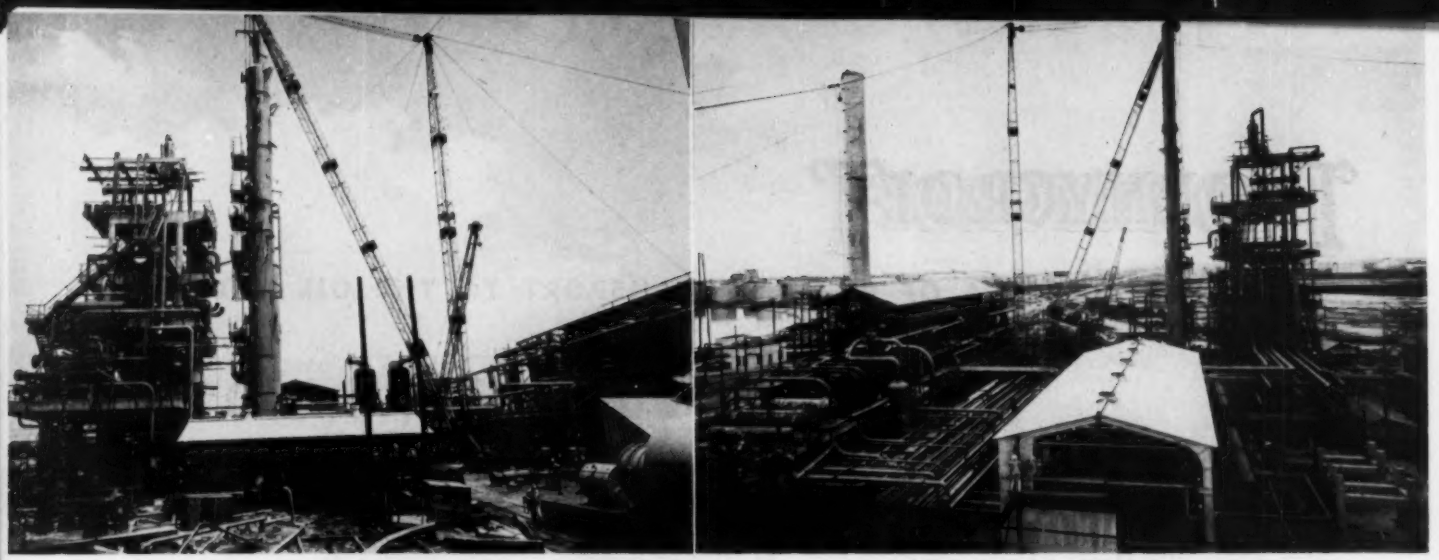


Ethylene plant: The pictures above show the progress of construction of the world's largest single unit for the manufacture of ethylene. This plant was designed, engineered and is being built by the Lummus Co. for Gulf Oil Corp. at Port Arthur, Texas. The new facilities are roughly estimated to produce 200,000,000 lbs. of ethylene per year. The ethylene will be made from by-product gases produced in the refining processes at Gulf's Port Arthur refinery. The ethylene plant will comprise a series of fractionating towers for separating ethylene, ethane and other hydrocarbons from refinery gases, and a series of cracking furnaces for converting the ethane to ethylene.

Deep Rock Oil Corp. is making extensive additions to its refinery at Cushing, Okla., including a lube oil blending and packaging plant under construction by the Chemical Plants division of Blaw-Knox Co., and a solvent refining plant engineered by M. W. Kellogg Co. to be installed next year. Phillips Oil Co. is adding an 8,000-barrel catalytic cracker and a catalytic polymerization unit to its plant at Okmulgee, Okla., with engineering in charge of the Fluor Corp. In New Mexico the first "packaged" air-lift TCC unit to be installed has just completed a six months run. This 6,000 b/d unit was built by the Southwestern Engineering Co. under license from Socony-Vacuum for New Mexico Asphalt and Refining Co.

In the Rocky Mt. region, Frontier Refining Co. is enlarging the catalytic cracking capacity of its Cheyenne, Wyo. plant to 6,500 b/d following designs by Universal Oil Products Co. At Salt Lake City, Utah, the Salt Lake Refining Co. is building a vacuum unit of 6,500 b/d capacity with construction by Bechtel Corp. Utah Oil Refining Co. is enlarging its power plant and installing a naphtha stabilizer built by Stearns Roger Co.

Phillips Petroleum Co. is introducing extensive alterations into its refinery at Woods Cross, Utah, which will raise its daily throughput from 4,000 to 10,000 b/d. A new cracking unit of 8,000 barrel capacity is being added together with other processing facilities for feed preparation, vacuum reduction, fractionating and gas plant equipment.

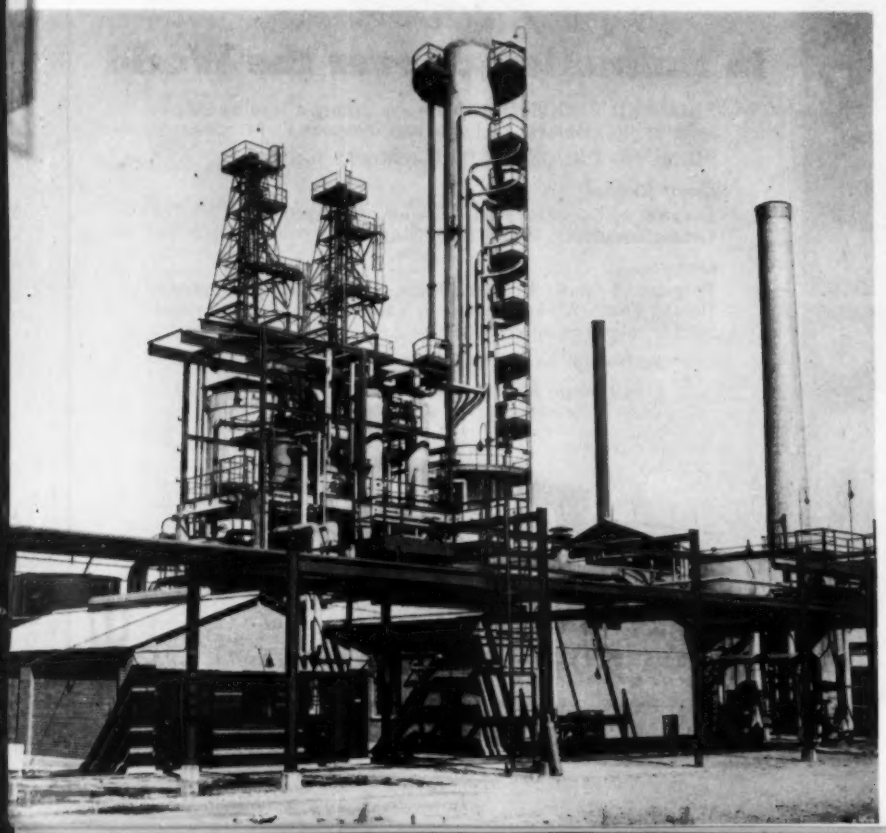
At Laurel, Mont., Farmers Union Central Exchange Inc. is installing a 5,000-barrel catalytic cracker and a polymerization unit. Design is by Universal Oil Products and construction by Refinery Engineering Co.

On the Pacific Coast construction activity maintains a high pace. Standard Oil Company of California is making several additions to its Richmond and El Segundo refineries. At the former it is planning to install a phthalic anhydride unit with a capacity of 13 million pounds yearly and a phenol unit of 35 million pounds yearly. Both are listed for completion in 1953 at an estimated cost of $4,900,000. At El Segundo, a benzene plant with a daily capacity of 850 barrels, a feed preparation plant of 23,000 barrels capacity, and a 10,000-barrel Platformer are under construction and will be completed before the end of the current year, representing an investment of $10 million.

Union Oil Company of California is conducting an extensive program of enlargement at its Wilmington refinery which includes a 40,000 b/d crude unit built by Fluor Corp., a catalytic cracking unit of 28,500 b/d constructed by Arthur G. McKee Co., an acid treater and rerun column installed by C. F. Braun Co., a sulfur and an ammonium sulfate plant.

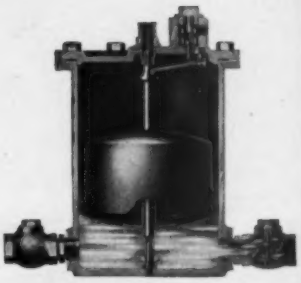
Shell Oil Co. is carrying on a modernization and replacement program at its Wilmington and Martinez refineries which, when completed, will raise the company's refinery capacity by about 100,000 b/d. General Petroleum Corp. is constructing a new Thermofor catalytic reformer unit at its Torrance refinery and has added a new

(Please turn to page 151)



Metallurgical grade coke and cat cracker feed stock are produced in this coking unit at Pure Oil Company's Toledo, Ohio, refinery.

Lifting oils and liquids with this AUTOMATIC PUMP



This automatic pump combines the good qualities of a pressure pump and a vacuum trap. Pumps hot condensate from low-pressure or vacuum vessels and lifts up to fifty feet or more; pumps boiling, cold or gaseous fluids (including oils); pumps petrol, benzine, dye liquors and alkaline liquors such as caustic, ammonia, etc.; drains sump holes, pits, excavations (where it may be fully submerged). Stops when there is no more liquid to pump; restarts automatically when liquid again flows into it. *Details of the 'Ogden' Pump (in five sizes) from:* SPIRAX MANUFACTURING CO. LTD., (Petroleum Dept.) Charlton House, Cheltenham, Eng.

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IF ROPE COULD TALK . . .

Left: Cleaning wire rope with a wire brush and applying a preservative before storing after use.

Below: An oil-bath for the fibre cores of wire ropes, during manufacture.

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is important in looking after wire rope.

When the rope is made, the fibre core—which forms a cushion on which the strands rest—is thoroughly impregnated with lubricant; both the strands and the completed rope are also well lubricated.

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Houdry laboratories near Marcus Hook, Pa., which are staffed with more than 200 research specialists.

other repair was required except on the flue gas lines from the kiln where erosion had caused loss of metal near elbows and other restrictions. All of the kiln internals were in excellent condition.

An interesting and novel experiment was conducted on this unit recently. In order to check the flow characteristics of catalyst through the Houdriflow system, engineers of the California Research Corp. conceived the idea of introducing into the unit a few pellets of catalyst that had been impregnated with a radioactive substance. The travel of the individual radioactive particles was traced by means of Geiger counters located at appropriate points along the catalytic equipment. The intensity of radiation from the particles was selected at such a value that the path and average velocity of individual radioactive particles could be plotted.

The survey proved that catalyst circulates uniformly through all parts of the unit. For example, the average velocity of catalyst particles flowing down the main seal leg from lift disengager into reactor was measured repeatedly over a period of several weeks with a maximum deviation from the mean result of less than five percent. A statistical analysis of other data collected in this manner demonstrates that the character of catalyst flow through the various elements of the system is streamlined. Consequently, uniform residence time of catalyst particles in the reactor and kiln is assured.

The Houdriflow plant operated by Shamrock Oil and Gas Corp. at Sunray, Texas, was designed to process 11,000 BPSD of charge stock consisting of 5,900 BPSD of mixed atmospheric and vacuum gas oils from Hutchinson-Moore County crude along with 5,100 BPSD of internal recycle. Filtrol clay catalyst is circulated in the unit at rates varying from 250 tons per hour to 360 tons per hour depending upon process requirements.

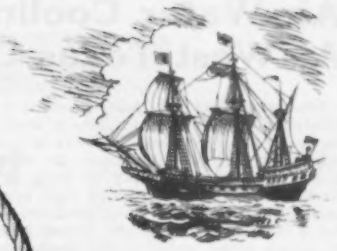
Due to seasonal fluctuations in crude runs at the refinery, the amount of charging stock available for the reactor varies from time to time. When cracking stocks are in short supply, it has been the practice to increase the internal recycle rate in order to maximize the production of catalytic gasoline and C_3 and C_4 unsaturates for polymerization. On other occasions, the fresh charge rate has been increased beyond the design quantity and the recycle charge rate has been decreased to provide the product distribution which this type of operation affords. After polymerization of the C_3 and C_4 unsaturates and pressurizing of the combined cracked and polymerized gasoline, the yield of total 10 lb/RVP gasoline from the unit is computed to be nearly 80 percent of the fresh reactor charge. This type of operation is decidedly attractive to refiners with a limited fuel oil market.

In March, 1952, the Shamrock unit was taken off stream for a general turnaround and inspection. As was the case with the other Houdriflow installations, the inspection disclosed it to be in excellent condition. Only minor repairs were required in the kiln and reactor. None of these elements showed any significant erosion from the flowing catalyst.

In addition to 10 Houdriflow units now in operation, two more are scheduled to go on stream in late 1952. These are the 11,500 BPSD unit of the Standard Oil Co. of Texas at El Paso, Texas and the 19,000 BPSD plant of Texas City Refining Co. at Texas City, Texas. Scheduled for operation in 1953 is the 18,500 BPSD plant at Gewerkschaft Emsland at Lingen, Germany and the 11,000 BPSD Sun Oil unit at Sarnia, Ontario.

Throughout the 25-years since the discovery of catalytic cracking by Houdry, a continuous research program has been carried out in the fields of both catalysts and processing methods and equipment. Latest development of the Houdry laboratories near Marcus Hook, Pa. is a catalytic reforming process which has been named Houdriforming. The new process is designed to give high yields of aromatics as well as gasoline with octanes above 100 F-1.

Closely associated with Houdry's research organization is the engineering and technical service for licensees. This group assists the refiner initially in the operation, maintenance and exploitation of his catalytic cracking facilities. Subsequent service may consist of continuing plant surveys, application of design studies which maintain maximum operating efficiency, direct assistance in incidental operating problems, and studies of changes in processing schemes required to serve changing needs.



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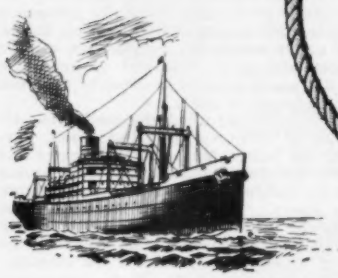

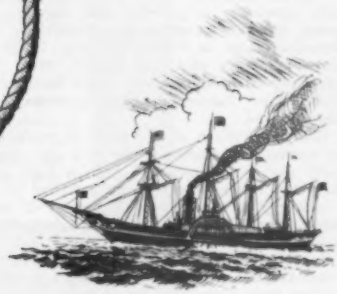

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AGENTS THROUGHOUT THE WORLD

Air-Water Cooling Unit Saves Water At West Texas Gasoline Plant

Processing plants and pumping stations unfortunately must be located at times in areas where the water supply is small or where it is of very bad quality for plant purposes. In some cases it has even been necessary to bring in water from considerable distances at high cost. Examples of such difficult water conditions may be found in West Texas in the United States and in certain desert areas in the Middle East and elsewhere where the oil industry operates

For the past two years Plymouth Oil Co. has been operating a gasoline and distillate plant under difficult water supply conditions in the Benedum field in Upton County, Texas. The plant processes about 28 million cubic feet of gas daily to produce about 4,000 barrels of distillate plus lighter products including butane and propane.

Cooling problem at the plant is made difficult by scarce water and by the fact that the operators are determined to obtain a high propane recovery. Refrigeration was installed to obtain a recovery of more than 75 percent of the propane in the inlet gas stream and substantially all of the butanes.

To obtain adequate cooling with the volume of water available, Plymouth installed a combination cooling unit developed by Hudson Engineering Corp. The unit, which has been named the "Combin-aire," combines the effects of the ordinary cooling tower, air cooled condensers and coolers, and water cooled condensers and coolers.

At the Plymouth plant the Combin-aire draws air through a cooling tower where the limited amount of water used in the plant is cooled and where simultaneously the air flowing through the tower is cooled and washed of dust. The cooled air then flows across tubes of the air cooled condensers and coolers. This cooled air is used for vapor condensers and final product coolers. Engine jacket water and process steam condensers use only ambient air for cooling since final temperatures need not be as low.

With air-cooled units in the past, stream temperatures were not usually cooled to temperatures below 130°F when the ambient air temperature was 100°F, a condition often encountered in West Texas, and it was therefore necessary to install a cooling water system.

The Combin-aire unit draws ambient air at 100°F or more through a cooling tower section and reduces it to near wet bulb temperature while simultaneously cooling the small amount of water required for final cooling. This air, which may vary from 75° to 85° in extreme summer weather depending upon wet bulb conditions, is drawn across air-cooled sections where stream temperatures are reduced to 100° to 110°F. In many cases, no additional cooling is required, and where added cooling is required, the best load is relatively light and can be handled by small atmospheric coolers located in the base of the cooling tower section.

The above description, which applies principally to summer operation, reduces the evaporation of water by an amount of heat equivalent to the difference between ambient air temperature and cooling tower exit air temperature. This saving is relatively minor compared to the amount of heat saved by the reduction of ambient air temperature at night or during periods of the year when the normal air temperatures drop to 80°F or below.

A system of louvers is provided to automatically by-pass a portion of the cooling tower when lower ambient air temperatures prevail, thus drastically cutting or completely eliminating water usage. In central and west Texas the ambient air temperature is 80°F or below over 70 percent of the total hours per year.

A recent study of water consumption on a gas processing plant in the Midland, Texas, area showed the following yearly average figures:

Total cooling load	88,000,000 Btu hr.
Water consumption with cooling tower only	190 gpm
Water consumption with air-cooled units for cooling stream to 150°F with 100°F air	96 gpm
Water consumption with Combin-aire unit	45 gpm

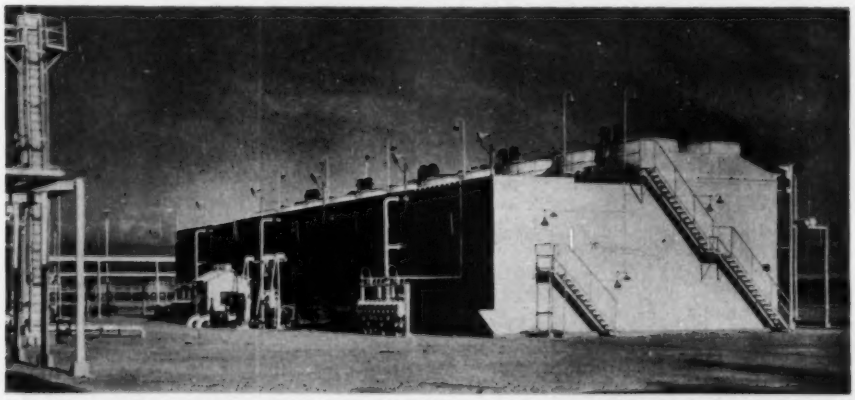
In addition to water savings possible through the Combin-aire, the overall investment cost is equal to or less than with conventional practice using water cooling tower, air-cooled units, and final coolers either atmospheric or shell and tube.

Where final stream temperatures are relatively high, such as with engine jacket water or exhaust steam condensers, the air-cooled equipment is usually not made a part of the Combin-aire unit.

Services usually included in a Combin-aire unit in a gas processing plant are ethane, butane and propane condensers where relatively low condensing temperatures are encountered. Lean oil coolers and gas compressor discharge coolers may also be included.

The Combin-aire unit discharges dry air to the atmosphere and the nuisance sometimes associated with cooling tower vapor is thereby eliminated. A substantial reduction in plant painting and other maintenance costs has been noted. The absence of objectionable water vapor makes it possible to locate the unit close to the processing area. This results in lower investment in lines and is an important advantage. The lowering of stream temperatures prior to water cooling substantially eliminates scale formation on exchanger tubes.

In some areas where water corrosion presents a severe problem, the unit may be substituted for water cooled exchangers and thus eliminate contact between water and metal surfaces. Water savings in this case are not important. Such an application may be found along the Gulf Coast where fresh water is high in organic content and releases oxygen on heating, causing severe corrosion of iron and steel exchangers.



Combination air and water cooler at Plymouth Oil Co. gasoline plant in Upton county, Texas. Elwood M. Payne photo.

Italy's Refineries

(Continued from page 112)

Enlargement of the refinery of Societa per l'Industria Italiana del Petrolia, a member of the Shell group, at La Spezia, will increase its daily throughput from 17,000 to 30,000 b/d when the work is finished early next year. At Naples, the Socony-Vacuum Oil Co. will install a Thermofor catalytic cracker and a catalytic polymerization unit during the coming year.

The Garrone Co. of Genoa has begun the enlargement of its San Quirico refinery, the processing capacity of which is to be increased to 4,900 b/d. Petroli d'Italia of Milan has practically completed the enlargement and modernization of its Fiorenzuola d'Arda (Piacenza) refinery which is to raise its daily processing capacity to 4,870 barrels and the Azienda Petroli Italiani (API) is installing an additional vacuum distillation unit in its Falconara (Ancona) refinery, the yearly processing capacity of which is to be increased to 12,000 b/d.

These enlargements are being carried out according to the old ECA approved programs. During 1952 the Italian Ministry for Industry and Commerce has decided, however, to stop issuing permits for building new refineries or enlarging existing plants. This decision has been taken owing to the fact that with the present yearly processing capacity of the Italian refineries, the output of white products exceeds the consumption of the Italian market, and the government is against the idea of assisting the refineries to export white products. Restrictions will force Italy to import fuel oil owing to the increasing conversion of industrial plants from coal to oil.

An effort is being made to overcome these difficulties by furthering the exploitation of natural gas through the construction of a pipe line system. At the end of 1951 this system included 211 miles of large diameter lines, 242 miles of medium size lines, and 308 miles of small diameter lines, a total of 761 miles. During 1952 a further 1,237 miles of lines are to be built, including the Cortemaggiore-Turin line which is to handle 3,500,000 cubic meters of gas daily. Finally, in 1953, a further 870 miles of gas lines is to be completed, thus allowing the full exploitation of the present output capacity of Italian gas wells in the Po valley, amounting to 10 million cubic meters daily. Owing to the fact that most of the leading industries are to be connected to the system, it is hoped to be able to reduce fuel oil consumption.

Further efforts are being made to exploit gas to replace motor fuel obtained from imported crude oil, and at Cortemaggiore the Azienda Generale Italiana Petroli gasoline plant has just been put in operation with a daily processing capacity of 3 million cubic meters of gas from which the following quantities of refined products are obtained per day: 150 tons of stabilized natural gas of 77 octane which might be increased to 90 octane by the addition of 0.5 percent of lead; 120 tons of propane and butane and a small quantity of kerosine; and in addition, 2,800,000 cubic meters of dry gas.

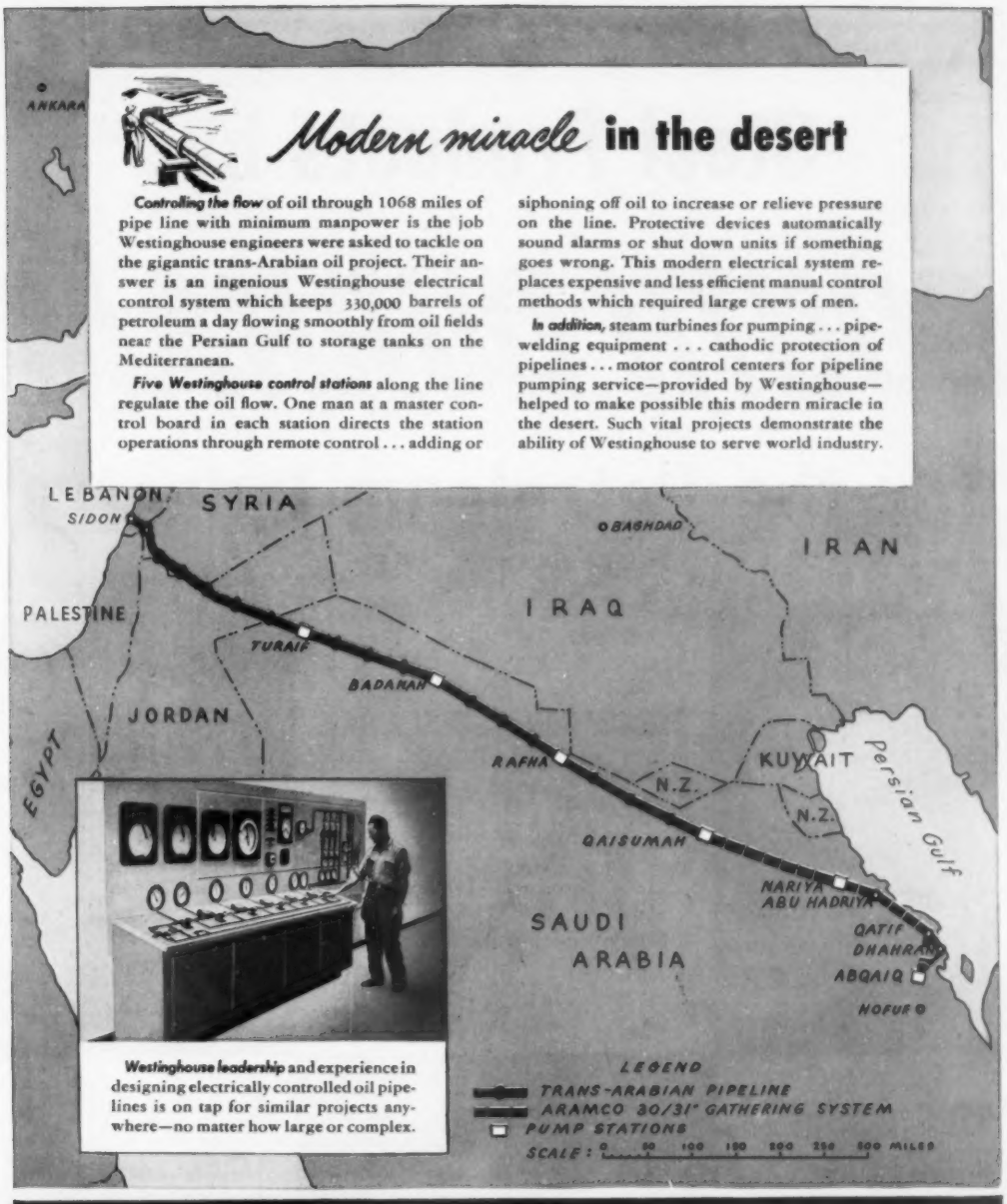
The Azienda Generale Italiana Petroli (AGIP) has arranged the sale of the distillate obtained from this plant throughout Italy under the trade mark "Super-cortemaggiore" with an extensive advertising campaign aiming to reduce the use of motor fuel obtained from imported crude oil.

To Study Fuel Situation

B. Brewster Jennings, president of Socony-Vacuum Oil Co., has been named to head a committee of the National Petroleum Council to study certain aspects of the Bunker C fuel situation. The report is to summarize trends in domestic manufacturing and to determine why yields of the heavy fuels have decreased. Requests for the study was made by the Deputy Petroleum Administrator.

Radioactive Insecticides

Gulf Oil Corp. is undertaking a study of pyrethrin insecticides with the aid of radioactive tracers. Gas flow counters will be used to aid the study. Radioactivity was imparted to the pyrethrin by supplying plants with active carbon dioxide in a vapor tight greenhouse.



Modern miracle in the desert

Controlling the flow of oil through 1068 miles of pipe line with minimum manpower is the job Westinghouse engineers were asked to tackle on the gigantic trans-Arabian oil project. Their answer is an ingenious Westinghouse electrical control system which keeps 330,000 barrels of petroleum a day flowing smoothly from oil fields near the Persian Gulf to storage tanks on the Mediterranean.

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In addition, steam turbines for pumping . . . pipe-welding equipment . . . cathodic protection of pipelines . . . motor control centers for pipeline pumping service—provided by Westinghouse—helped to make possible this modern miracle in the desert. Such vital projects demonstrate the ability of Westinghouse to serve world industry.

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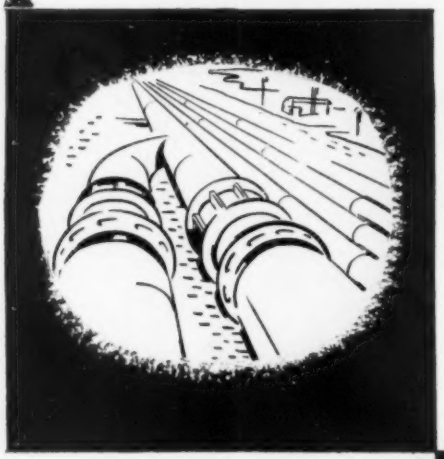

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U. S. Refiners

(Continued from page 144)

distillation tower to increase the production of aviation fuel components. Richfield is planning a catalytic cracker and a feed preparation unit for its Watson refinery. Monsanto Chemical Co. has completed plans for erection of a phenol plant at Avon, Calif.

In addition to the new plants and units noted, a great number of installations are under way or planned, many of them among smaller refineries which will contribute to the national defense program. These have been aided in numerous cases by the provision for rapid amortization adopted by the Defense Production Authority. Altogether, the projects authorized will keep the petroleum side of the defense program well up to requirements, provided the necessary materials for construction are forthcoming.

The Petroleum Administration for Defense has furnished WORLD PETROLEUM with some figures on new capacity for basic refining, benzene, and elemental sulfur which is to go into operation in June of this year and in the July-December period of this year. The figures come from a check of work under way, as reported to the PAD.

Basic refining includes 35 projects scheduled for completion in June, 1952 with an added capacity of 68,720 b/d. In the last half of the year, added capacity scheduled for completion is 345,112.

There are five benzene projects scheduled for June 1952 completion with a capacity of 820 b/d, and in the July-December 1952 period, 2,138 barrels of daily capacity will be added.

Four elemental surfur projects are to be completed before the end of the year with 136 short tons daily capacity.

The PAD also has listed by companies all refinery expansion projects in the United States recommended through April 1952 for accelerated tax amortization. The list is divided into groups of large, intermediate and small companies. Large refiners are defined as those running 50,000 b/d crude or more, intermediate refiners 20,000 to 49,999 b/d, and small refiners less than 20,000 b/d.

After an interruption caused by confusions of the recent strike, PAD has now resumed processing applications for certificates to cover the remainder of the expansion program deemed desirable. The program calls for starts on new construction to add 500,000 barrels of new capacity before the end of 1953. Details of the certificates recommended through April are given in an accompanying tabulation.

Control Selection Bulletin

A new eight-page selection guide for a wide range of electric and electronic controls, devices, and accessories has been announced as available from the General Electric Co., Schenectady 5, N. Y. Designated as GEA-5781, the bulletin contains quick-reference selection data, photographs, and listings of additional publications which give complete information on all the equipment.

Products included are: manual, magnetic, combination, and reversing motor starters; pushbutton stations; relays; limit switches; solenoids; photo-electric relay; electronic timer; electronic relay; pressure and vacuum switch; float switch; pressure governor; reduced-voltage starter; Thymo-trol drive; and smoke density indicator and control.

New C.E.C. Subsidiary

CEC Instruments, Inc., has been formed as a subsidiary organization to handle sales and service work on instruments manufactured by Consolidated Engineering Corp., Pasadena, Calif. Officers will be Philip S. Fogg, president; James B. Christie, secretary; Hugh F. Colvin, treasurer; and Robert L. Smallman and Harold F. Wiley, vice presidents. Main office of CEC Instruments, Inc., will be at the Consolidated plant at 300 North Sierra Madre Villa, Pasadena. All new offices have not yet been announced, but those already in operation are in New York City, Philadelphia, Dayton, Chicago, and Washington, D. C.

U.S. Visitors at Poza Rica

A group of U. S. industrial, banking and business leaders, headed by Gaylord C. Whipple, president of the Illinois Chamber of Commerce, recently inspected Petroleos Mexicanos' refinery and sulfur plant installations at Poza Rica. The visitors, who made the trip in two Pemex planes, were escorted through the installations by Jaime Merino, superintendent in charge of the oil field.

Hungarian Refinery Construction

The Petrochemia plant, now under construction near Szoeny, Hungary, will begin refining operations in October of this year. The three river tankers of crude now shipped via the Danube daily to Ismalia, in the Ukraine, for refining and return can then be processed at home. It is also planned to process Czech petroleum at the Petrochemia plant.

Ebensee Plant Sold

The Austrian Association of the Crude Oil Industry has announced that the Ebensee refinery in the U. S. occupation zone was recently sold to an Algerian company through the NOVOEL (Neueuropaeische Oel Ges.m.b.H). The equipment has been shipped to Algiers for refining Algerian crude and, reportedly, some imported petroleum. An Austrian engineer and several technicians, under contract with the Algerian company, accompanied the shipment.

Polish Refinery Rebuilt

The Glinnik refinery in Poland has pledged itself to process twice the amount of crude refined last year. After Poland had repaired the plant, partly destroyed during the war, the Soviets furnished modern machinery to enable the Glinnick plant to reopen in 1951. Prewar capacity was 1,500 b/d.

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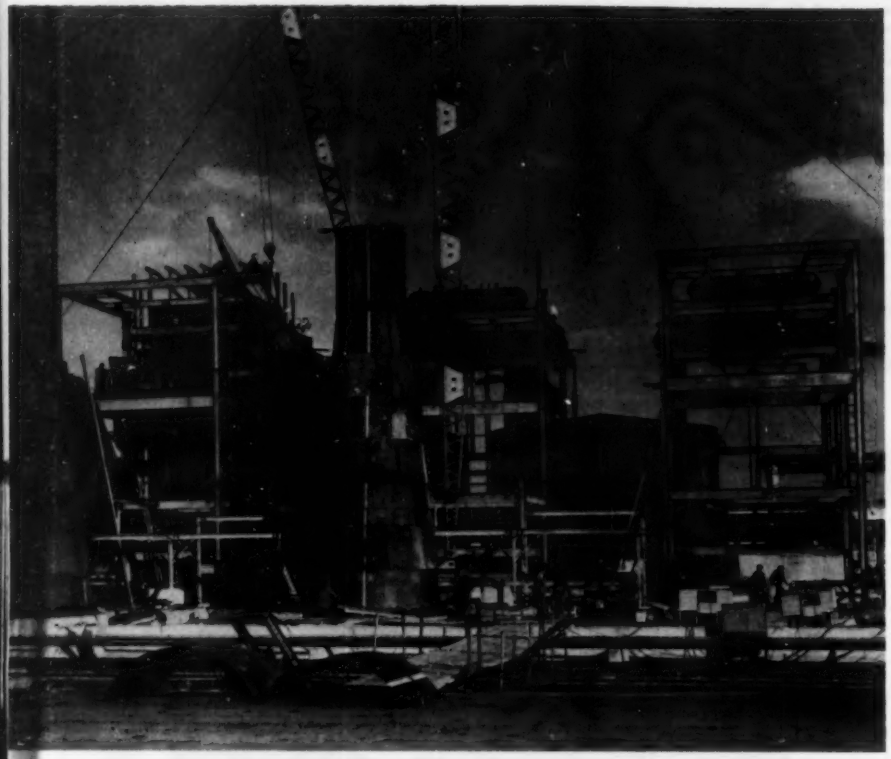

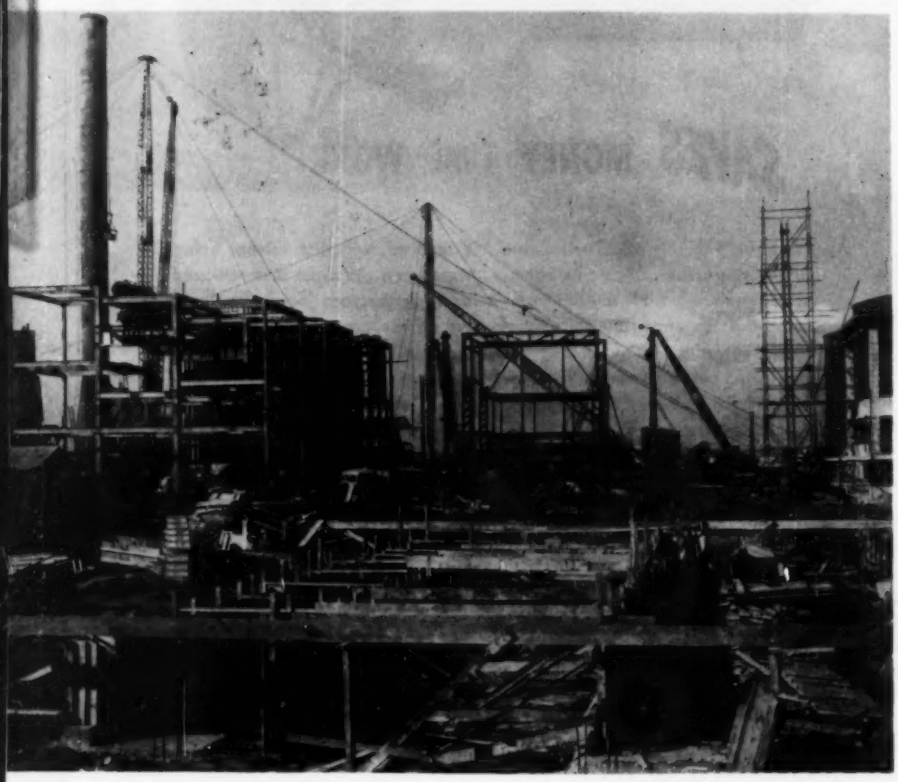

Coryton Refinery

(Continued from page 111)

The crude oil charging pumps for this unit are situated at the tank farm 5,000 feet away from the unit, the crude passing through the usual heat exchangers and furnace to the tower.

In the atmospheric stage the oil is distilled to 50 percent residue, light overheads and naphtha, and gas oil side fractions. The overhead light products pass through a stabilizer which is combined in the unit.

The heavy naphtha goes to a thermal reformer of Socony-Vacuum design, and is a standard type unit of 2,500 barrels per stream day capacity. It has a built-in stabilizer, the overhead going to gas treatment and the bottoms to fuel blending for sale.

The 50 percent residue from the atmospheric side passes through the heater to the vacuum tower from which an overhead and three side streams are taken off, the residue passing to the propane de-asphalting unit. The atmospheric tower is 12 ft. diam. by 105 ft. high with 34 bubble trays. The vacuum tower is 19 ft. diam. by 80 ft. high with 28 bubble trays.

The lubricating oil treatment plant is designed to refine 2,000 b/d of finished lubricants in blocked operation by the continuous treatment of accumulated batches of various grades. The lubricant fractions for treatment will be the side streams from the vacuum column and the residue after de-asphalting.

Apart from the preliminary treatment of this residue, the process is the same in principle for all fractions involving furfural solvent treating, MEK dewaxing, and Thermofor continuous percolation.

The 20 percent asphaltic residue will be propane de-asphalted in order to provide the raw material for bright stock manufacture prior to undergoing the standard treatment.

In the MEK dewaxing of this portion, the slack wax separated is of such a quality that it is further processed for the production of microcrystalline wax. This entails de-oiling of the wax by further MEK treatment and de-colorizing by a final clay treatment. The slack wax from the MEK treatment of the side fractions of the vacuum unit will be used as part of the feed stock of the TCC unit.

The Thermofor continuous clay percolation unit for the finishing treatment of the lubricants is entirely new, and is expected to give better results than ordinary units working on the percolation system.

The air-lift Thermofor cracking (TCC)

Above, boilers being installed and stacks built for power plant. Below, looking northwest toward power plant structure.

CORYTON REFINERY

Mechanical Engineering

Construction

by

Costain-John Brown

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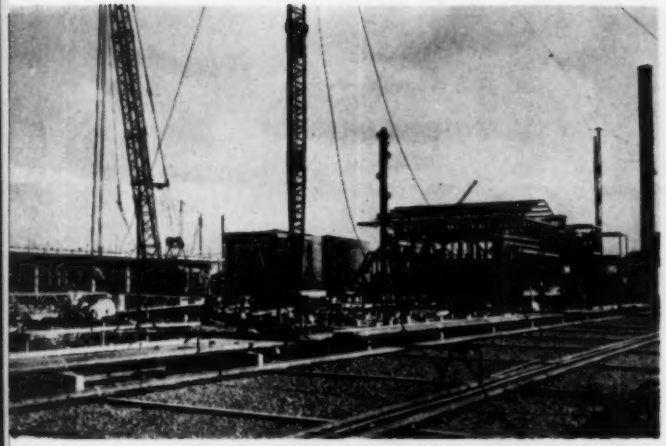

Pipe tracks being installed adjacent to crude still.

Looking north along "J" street.

unit of 10,000 b/d capacity was built to the design of Socony-Vacuum Oil Co., Inc. of New York, and engineered by The Lummus Co.

The feed is a wide gas oil range cut, together with slack wax from the MEK treatment of the vacuum unit side streams and furfural extract.

In this unit the feed is brought up to cracking temperature in a furnace, from which it is passed into the reactor in the form of vapor or a mixture of vapor and liquid. Here it meets catalyst from the regenerated catalyst store and the optimum cracking takes place, coke being deposited on the catalyst during the reaction. The cracked vapors pass into the fractionating tower, where they are separated into gas, cracked spirit, light fuel oil and heavy fuel oil.

The spent catalyst then passes into the regenerator where the carbon is burned off by aid of a current of air. The heat generated from this reaction is removed by cooling coils, in which steam is generated at 600 lbs. pressure, and passes into the refinery steam main.

The regenerated catalyst falls into the lift pot whence it is blown by air more than 200 feet high to the impactless separator and from there to the reactor, thus completing the circuit. In this process 300 tons of catalyst is circulated per hour.

The stabilized spirits from the atmospheric unit, the reformer unit and TCC unit are separately treated in a Socony-Vacuum-Shell solutizer unit and are then blended to motor spirit for sale.

Water for steam generation, process treatment and domestic purposes is supplied by the local water board through a 12-inch main to a 55,000-barrel storage plant. It is conditioned for steam raising by hot-lime and hot zeolite treatment.

The boiler plant consists of three boilers of 200,000 lb./hr. capacity each working at 600 psig and 750°F. Three 5,000 KW turbo-generators will generate power at 11 KV 50 cycles. No outside power is being bought.

The turbines are double extraction-condensing, first extraction at 125 pounds 100°F. superheat, and second stage extraction-induction at 20 pounds. The steam extracted is used mostly for process and heating. It is expected that by this method only 50 percent of makeup water will be required.

Electricity is generated at 11 KV 50 cycles, and stepped down to 3.3 KV for large motors, to 415 volts for small motors, to 240 volts for lighting, to 120 volts for instruments, and to 25 volts for service lights, such as hand lamps, this being a safe voltage for the purpose.

All cooling water in the process section of the plant goes to a common separator and the final clarification of the oil contaminated portion is through an API type separator. As mentioned before, clarified effluent rejoins the river below the plant at Holehaven Creek.

The tanks formerly in service on site are being used for crude oil storage, having a capacity of 600,000 barrels or about a month's requirements. Finished storage is being supplied to hold a month's make of all products. Motor spirit tanks are of the floating roof type. Intermediate and finished product storage tanks for other products have fixed roofs.

Deliveries of finished products will be by water or road, but if railroad loading is required, facilities can be added, the traffic being handled by a light railway about one mile long which connects with British Railways at Shellhaven.

A ring water main covers the whole plant at 150 lbs pressure, with the fire pumps located at the power plant. One fire truck will be located in the garage and one in the old tankage area. All these machines are equipped with foam and all modern equipment.

An ambulance is located in the fire equipment area, and in the first aid department, medical orderlies will be on 24-hour service, with a medical officer in part time attendance.

Ample warehouse and repair shop buildings have been erected, the latter being fitted with traveling cranes, fitting and turning shops, welding sections, blacksmith's shop and instrument repair shop. Carpentry and insulation work will be carried out in a separate building. The main office buildings comprise offices, locker rooms, canteens, laboratory and lavatories. The canteen will seat 300 people for meals, and all the buildings have been planned with possible extension in view.

In addition to the dwellings and the institute existing when the site was taken over, 16 new houses for key staff members have been erected, while 225 houses have been assigned to the employees of Vacuum Oil Co. in the neighboring town of Basildon.

The main contract for the refinery was placed with The Lummus Co., Ltd. Foster Wheeler Co., Ltd. is also a main contractor. British industry supplying equipment and services is represented by over 200 firms, including Babcock & Wilcox, Ltd.; Cargo Fleet Iron Co., Ltd.; Costain-John Brown, Ltd.; Crompton Parkinson, Ltd.; Franki Compressed Pile Co., Ltd.; International Combustion, Ltd.; William Kenyon & Sons, Ltd.; John Laing & Son, Ltd.; Metal Propellers, Ltd.; Metropolitan-Vickers Electrical Co. Ltd.; Sir Robert McAlpine & Sons, Ltd.; Wm. Neill & Son (St. Helens), Ltd.; Stewarts and Lloyds, Ltd.; and Whessoe, Ltd.

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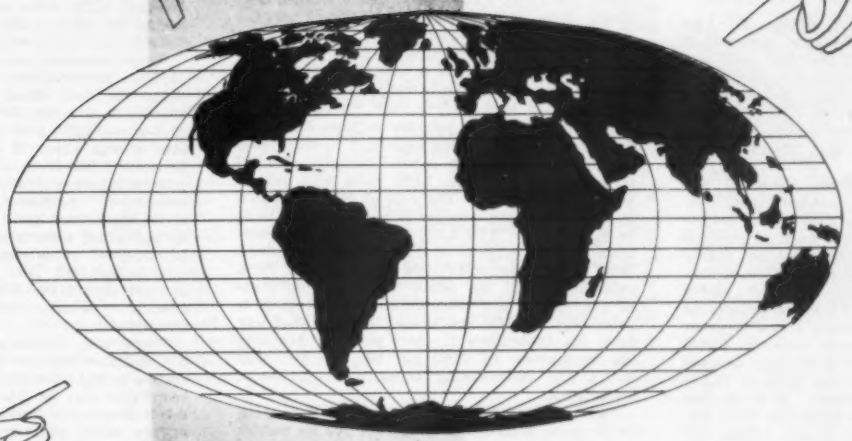

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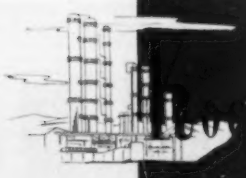

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Electrical Distribution Systems

(Continued from page 89)

primarily due to the lack of availability of standard 550- and 575-volt utilization equipment. The 600-volt system lost out completely during World War II which was a period of high standardization. During this period the percentage of standard 550-volt induction motors decreased from 11 to four percent of the total standard induction motors made. Today 600-volt systems are limited almost entirely to expansion of present 600-volt systems. Technically and theoretically, 600-volt systems should be more economical than 480-volt systems, but availability of utilization equipment has made them obsolete.

Three-phase versus one-phase circuits have not been mentioned because three-phase voltages are used exclusively for power work. Single phase power is used within the refinery, but this is at 120 volts and is usually for lighting and small appliances. This load is as a rule fed from 120/240-volt single phase transformers. When this load is 50 KVA or less, the single phase 120/240 three wire system usually proves more economical than the three phase, four wire 208Y/120-volt system.

Let us now consider which voltage will best be suited for a primary electrical distribution system. All refineries except the very small and the extremely large should select a system within the 2,400 to 15,000-volt class. Small plants having a maximum demand of 1,500 KVA or less and cable runs of 1,000 feet or less will probably have one load center and, therefore, 480 volts is all that is required.

The trend in modern refinery electrical distribution systems is definitely toward higher voltages. Many studies indicate that in the majority of cases 4,160 volts is the most economical between 1,500 KVA and 10,000 KVA for plants generating or receiving their power from a supply transformer, and 13,800 volts for plants having a capacity of 20,000 KVA and generating or receiving power from a supply transformer or 13,800-volt source. The range between 10,000 and 20,000 KVA may require some very detailed study before deciding upon either 4,160 or 13,800 volts as being more economical. It is in this range that the master plan plays the most important part in selecting the proper voltage for refineries so that the plan will not outgrow the original primary system.

Advantages of the higher voltage systems include economy and simplification.

Perhaps the best way to select primary voltage is to compare one voltage to the other. Two of the major reasons for selecting 4,160-volt systems over 2,400-volt systems are lower first cost and greater allowance for expansion. On the cost side, 4,160-volt switchgear for a given interrupting rating costs less than 2,400-volt switchgear. In modern electrical distribution systems of the load center type more KVA per circuit can be carried at 4,160 than at 2,400 volts.

As a rule, 1,200-ampere breakers are sufficient at 4,160 volts, but at 2,400 volts, 2,000-ampere breakers may be needed. The 2,000 ampere breakers are considerably more expensive. Cable costs are generally less on the 4,160-volt systems than 2,400-volt systems. At the present time, some refinery distribution systems are quite large and are fed from large generating stations, which means that circuit breakers must have adequate interruption capacity. The maximum interrupting rating obtainable is 44,000 amperes which, for 2,400-volt service, is 183,000 KVA, and 4,160 volts is 316,000 KVA.

The influence of motors on the choice of 4,160 or 2,400-volt systems does not in general alter the selection of the voltage for the primary distribution system. Motors rated about 40 hp are generally available with a rating of 2,300 volts. It is often thought that using motors directly from the primary system at 2,300 volts gives the lowest overall cost because the transformers have been eliminated. Studies have shown that it is nearly always less expensive on all-over electric cost to install a 4,160-volt system and operate all motors 200 hp and smaller on 480 volts and above 200 hp at 4,160 volts. These studies definitely show the economic advantages of the 4,160-volt system in most cases. However, when the refinery is served directly from the utility at 2,400 volts, then, as a rule, it is more economical to use 2,400 volts unless the circuits are long and the load centers very widespread.

In systems with a primary voltage exceeding 5,000 and a concentrated load with motors rated 200 hp and above with a total capacity of 7,000 hp maximum per bus, 2,400 volts will usually be more economical. The cost of transformation is about the same whether it is to 2,400 volts or to 4,160 volts. The 2,300-volt motors and controls are less expensive than 4,000-volt motors. With the concentrated load in one small spot, cable costs will not offset the additional costs of the motors and controls since the copper is primarily used for the branch circuits that run from the controllers to their motors. Limiting the horsepower to 7,000 per bus, we can stay within the interrupting capacity of 2,400-volt switchgear.

To sum up 4,160 and 2,400 volts: it is generally more economical to operate 200 hp motors and less at 440 volts. Due to the layout of refineries with a load center at each still or pump house, it is generally more economical to select 4,160 volts rather than 2,400 volts. Short circuit ratings on 4,160-volt breakers may not be reached as rapidly because 4,160-volt breakers can be purchased up to a rating of 316,000 KVA while maximum rating obtainable on 2,400-volt breakers is 183,000 KVA. In general, fewer feeders, fewer breakers, relays, potheads, etc. are required on a 4,160-volt system than on a 2,400-volt system of the same capacity. This also reduces the space requirements for switchgear which may or may not reduce the building costs. From the safety standpoint, it is believed the 4,160-volt Y system is just as safe as the 2,400-volt delta.

Considering higher voltages, it is found that 13,800-volt motors cost about two dollars more per horsepower than 6,900-volt motors, but this cost is more than offset by the fact that cable costs are less on 13,800-volt systems of the same capacity. Unit substation transformers cost less for stepping down to 7,200-volts than to 13,800-volts. However, 7,200-volt switchgear is more expensive than 13,800-volt. The overall costs for systems indicate a saving of about five dollars per KVA for 13,800-volt systems. This spread may be even greater if the circuit breakers require 2,000-ampere rating at 7,200-volts where the same capacity per circuit can be handled with a standard 1,200-ampere breaker at 13,800 volts.

There are certain systems where 7,200 volts is the most economical voltage. This is in very large systems where motors of 2,000 hp and larger are used and 7,200 volts is the utilization voltage and the primary transmission voltage is 33 KV or higher.

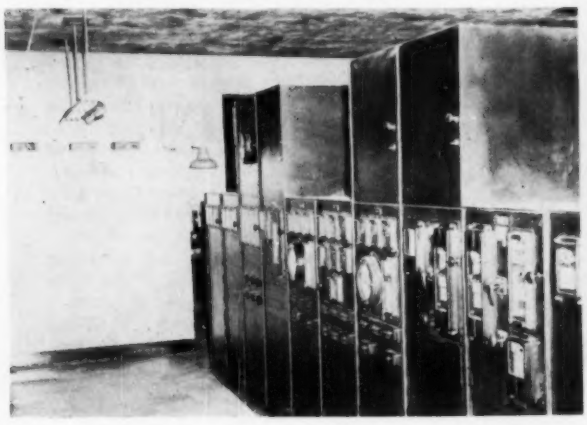
From the above discussions, two voltages are favored: 4,160 volts and 13,800 volts. Now it has to be decided when to use 4,160 volts and when to use 13,800 volts.

Many refineries are located near power plants or have power plants that generate at 13,800 volts. In such cases it is usually more economical to use the 13,800-volt systems down to as low as 10,000 KVA if the plant is spread out over a large area. It is believed that for plants between 1,500 KVA and 10,000 KVA a 4,160-volt distribution system is generally the most economical. Between 10,000 and 20,000 KVA, it is impractical to make a definite statement as individual plant requirements would have to be analyzed to determine which voltage is the most economical. For refineries with a capacity of more than 20,000 KVA, it is usually more economical to install a 13,800-volt electrical distribution system.

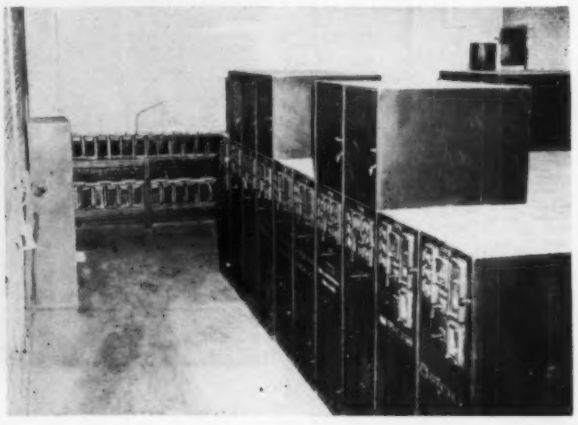
There may be some refineries that require a distribution system so large that a 13,800-volt system is not adequate. If this is so, metalclad switchgear may be obtained up to 34.5 KV. Above this voltage, you must go to the open type substation which may create quite a problem in refineries.

Point Five: The selection of the circuit arrangement is governed by service reliability, provision for maintenance, and provision for growth. The ideal system is one in which there is a choice of two or more sources of feed to each unit load center with an adequate power circuit breaker for each unit load center substation. This system is the most expensive and hardly justifiable. There are variations of this such as one feeder to each load center substation provided with an adequate power circuit breaker, and both of these

Switch stations on 13,200 volt distribution system.



13,200 volt substation switch gear.



systems with a disconnecting switch in place of the power circuit breaker at each load center substation. The disconnect switches are capable of interrupting magnetizing current only and are interlocked with the secondary breaker. This design is very common and is in compliance with Paragraph 4,512 of the National Electrical Code.

If all transformers have the same KVA rating, then four to six or even more may be connected to the same primary feeder without individual overcurrent protection. If there are as many as six or more transformers on one primary feeder, there must be diversity in the loads on the different transformers otherwise the primary feeder circuit breaker will trip on normal overloads. The radial circuit arrangement is the most popular. Considering all industrial plants, it is about an eight to one favorite. Service reliability is good on the radial system. Maintenance may be quite a problem as taking a cable out of service may mean a power interruption to quite a large area of the refinery. To compensate for this, some engineers prefer the selective primary system. This amounts to two primary cables being available to each transformer, the operator or the engineer selecting the most desirable cable for each transformer. This is the system used in the refining department of Phillips Petroleum Co.

Where greater flexibility and the ability to take both a transformer and cable out of service without curtailing power for long periods of time is required, the secondary selective circuit arrangement may prove to be the most desirable. This is also more expensive as more tie cables and breakers are required. Phillips has found this system to be very advantageous in areas of large load concentrations where two or more transformers are required in a small area. The secondary selective load center system ranks second in popularity to the simple radial system. This system may be designed to provide complete standby for each transformer or standby only for the critical load, and the cost will vary accordingly. Phillips has not used this system very extensively and does not believe it is economically justified due to distances between load centers and the reserve capacity necessary in the transformers to make the system work (transformers being such dependable pieces of equipment).

There is also the secondary network arrangement. This system is used by large power companies for serving commercial areas of large cities. This system may be used in refinery distribution systems.

There are other arrangements of secondary circuits such as parallel operation of transformers. In refinery systems, the size of the transformers may be so large that parallel operation may get into interrupting capacity difficulties on secondary switchgear. The possibilities of secondary circuit arrangements are so numerous and can become so complicated that we just touch on the more popular arrangements.

Point Six: In studies made of substation sizes, it has been found that 500 KVA and 1,000 KVA load center transformers are best suited and most economical for use on 480-volt secondary systems, 300 to 750 KVA on 208Y/120-volt systems and also 240-volt systems. There are several factors which affect this cost such as load magnitude, primary cable, unit substations, secondary cables, primary switchgear, secondary switchgear, and primary voltage. These factors combined in their proper proportions will give the most economical solution to the transformer size for the load center.

Point Seven: Short circuit protection should be designed to fit the master plan for the refinery, not for just the immediate equipment. In recent years, the procedure for calculating short-circuit currents has been greatly simplified. This should promote the proper short-circuit studies on all refinery distribution systems that have not been previously studied. From these studies, proper short-circuit protective devices can be specified and installed.

The three basic sources of short-circuit current are: (1) generators, (2) synchronous motors and synchronous condensers, and (3) induction motors. Transformers are not a source of short circuit current. They only change the system voltage and the magnitude of the current and are not a generating device. It is very important that all the above sources be considered if a study is to be of any value.

The generator produces short circuit current because after the short occurs, it will continue to produce voltage due to the field excitation being maintained and the prime mover continues to drive the generator. The magnitude of the short circuit current is limited only by the impedance of the generator and circuit between it and the short.

The synchronous motor produces short-circuit current because the short circuit reduces the system voltage to a low value. Therefore, the motor stops delivering mechanical energy from electrical energy, but keeps rotating because of the momentum of the load and the rotor. The DC field still supplying excitation, the momentum of rotation causes the motor to produce short circuit current for many cycles after the short occurs.

Short circuit contribution from induction motors is also produced for a few cycles after the short occurs. The flux in an induction motor cannot change instantly. Therefore, the rotor turns due to momentum after the loss of voltage, the flux is present and the motor acts as a generator feeding the fault. This fault current will continue until the flux has decayed.

Short circuit studies and application of circuit breakers and fuses on an interrupting duty basis is a very interesting subject in itself. I am sure that most of you have seen some type of a switching device after it had been damaged by interrupting short circuit current exceeding its rating.

Point Eight: Considering overcurrent protection, the radial primary cable can be protected by overcurrent relays set for six times the current rating of the smallest unprotected transformer on the system.

The secondaries of transformers should have a circuit breaker of adequate rating and adjustable magnetic trips so as to take advantage of cascading to reduce the cost of the system. The overcurrent devices throughout the system should be selected to provide adequate, properly set, selective tripping in case of over-current conditions. The relay system should be the simplest that will do the job.

Point Nine: System grounding is a subject upon which volumes have been written. Design your refinery electrical system using the best modern grounding practices. Be sure also that all pieces of electrical apparatus are well grounded.

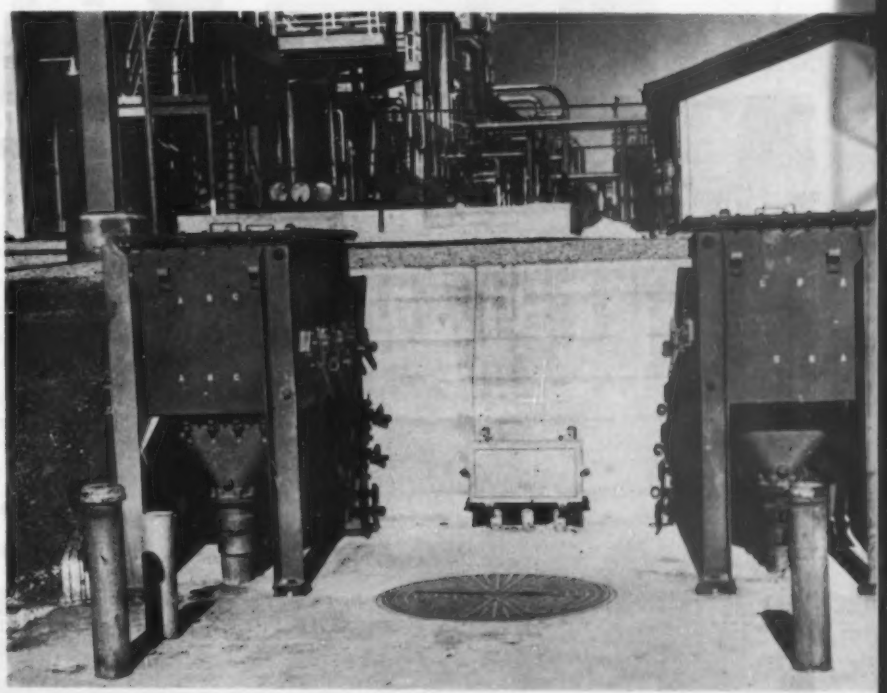
Point Ten: A study of the types of distribution systems indicates that the overhead system using cross arm construction is the least costly, the least reliable, and most hazardous within refineries. The overhead cable system is about in the same group, however reliability is somewhat better. The overhead conduit system, running the conduits along the pipeways, is used in some plants and has given very fine service. However, this exposes the electrical distribution to definite fire hazards. Some safety men object to this practice. Phillips Petroleum Company does not use this method in its refineries. However, it is used by the natural gasoline department.

Direct burial cables have been found to work very well in certain refineries. This system works very well where the refinery is spread out and the distance between takeoffs for load centers is very widespread. The service reliability is very good on this type of system as the system is underground and therefore not subject to weather disturbances, fires, trucks, cranes, etc.

The ultimate of course is the conduit, manhole and cable system. This system offers all the advantages of the direct burial cable system without its disadvantages. It is more expensive, but is the one preferred and being used in most of the refinery distribution systems. We have one system that has been in operation 20 years and has given us the utmost in system reliability.

In conclusion, it should be emphasized that electric power is a product component of the modern refinery as much as is crude oil. An electric power failure completely stops production. The electrical design engineer must be convinced that he has under his control the backbone of the refinery. With such a conviction, he will design an electrical system which will fulfill safety requirements and be adequate and readily adapted to future plant expansion.

13,200 volt switch gear.



Kellogg Names Swanson

Paul F. Swanson has been named manager of the process engineering department of The M. W. Kellogg Co. In his new position, Mr. Swanson will be in charge of his firm's large staff of process engineers, which is currently designing more than a score of major petroleum refining and chemical processing plants throughout the world.

Mr. Swanson came to Kellogg 25 years ago, immediately upon his graduation as a chemical engineer from the University of Kansas. He was prominent in the development of the first fluid catalytic cracking process and recently has helped develop fluid hydroforming.

Included among the current Kellogg design projects with which Mr. Swanson will be associated are several processing "firsts" and also a number of jobs of unusual scope: the world's first Synthol plant, a Kellogg design for the production of gasoline and diesel fuel from coal, to be erected in South Africa; the world's first plant for the production of phenol from a petroleum derivative, cumene, to be located in Canada; Italy's first comprehensive petrochemical plant; several large, complete refineries throughout the world; and ammonia, oxo-alcohol and phthalic anhydride plants for the U. S. and England. These are in addition to Kellogg's continuing work for domestic and foreign oil companies on established refining processes such as fluid catalytic cracking, catalytic polymerization and alkylation.

Cyanamid Increases Sales Staff

American Cyanamid Co. has appointed E. W. Koffman to the sales staff of the Industrial Chemicals Division's New York District office. He formerly served as purchasing agent for the division and technical representative for the petroleum chemicals department. Mr. Koffman will assist in the sale of products of the petroleum chemicals department in southern New York State.

P. F. Swanson

Penn-Grade Re-elects Streeter

Clarendon E. Streeter, Bradford oil producer, has been re-elected president of the Pennsylvania Grade Crude Oil Association for a fourth one-year term.

Managing partner in Bradley and Streeter and Streeter Oil Co., he is an officer and director of Bradley Producing Corp., Empire Gas and Fuel Co., Ltd., and Sterling Injection Molding, Inc. He is also a director of Texas Gulf.

C. G. Johnson of Oil City, treasurer of Quaker State Oil Refining Corp., was elected an assistant treasurer, succeeding W. R. Reitz. Other association officers re-elected include: George J. Hanks, first vice president; C. A. Chipman, second vice president; Fayette B. Dow, vice president and general counsel; Samuel Messer, treasurer; F. W. Alcorn and C. L. Suhr, assistant treasurers; and W. C. Wenzel, executive manager. Two new directors elected were L. G. Lent and M. E. Mitchell.

Gulf Expands Storage

Gulf Oil Corp. is building tankage to add 915,840 barrels to storage capacity at points along the Plantation Pipe Line between Baton Rouge, La. and Greensboro, N. C. In its announcement of the project, which is part of a $200 million program, the company acknowledges the acute need of increased storage in view of the growing demand for gasoline, distillates and burning oils, and states that construction will begin immediately.

Largest of the new installations will be at the Greensboro terminus of the pipe line where five tanks with a combined capacity of 290,000 barrels will be erected. Other stations will be at Charlotte, Belton, and Spartanburg, S. C., Birmingham and Montgomery, Ala., and Collins, Miss.

Du Pont's 150th Anniversary

The 150th anniversary of the establishment of E. I. du Pont de Nemours & Co. will be observed July 18 at the site of the first du Pont powder mills on the banks of Brandywine Creek, near Wilmington, Delaware. The ceremonies will include a simple historical dramatic prologue, addresses by company officials, and the dedication of a marker on the site of the first plant. Crawford H. Greenwalt, president of the Du Pont Co., and Henry B. du Pont, vice-president and member of the executive committee, will speak, while Walter S. Carpenter, Jr., former president and now chairman of the board, will dedicate a marker formed by one of the two huge millstones ordered from France by the founder of the company in 1801.

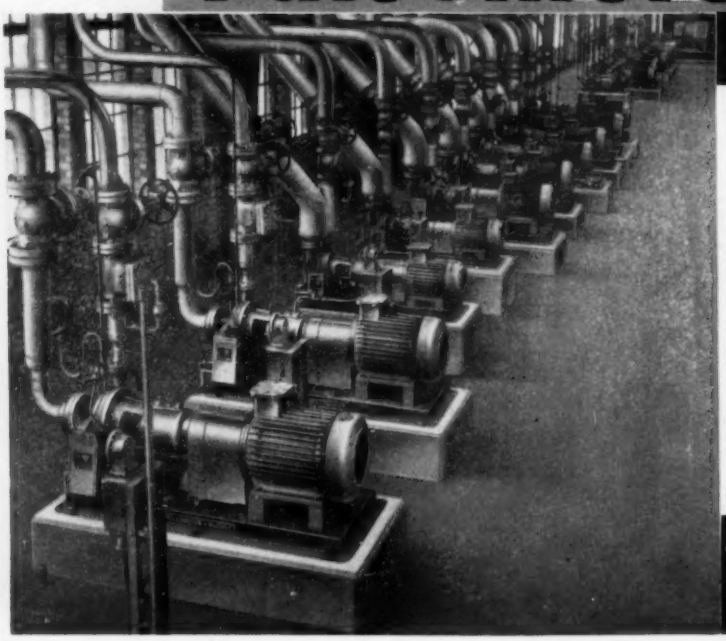
Graver Water Conditioning Promotions

Graver Water Conditioning Co. has appointed Harold R. Fosnot as assistant general sales manager and Leonard Limon as manager, sales engineering department.

PACIFIC

Pulsometer

OIL REFINERY PROCESS PUMPS



The illustration shows some of the 65 Pulsometer Pumps installed at Shell Haven refinery, which since going "on stream" has not had to shut down through any failure of the pumping equipment.

Other pumps are also installed or in process of manufacture for refineries throughout the world, in particular at :-

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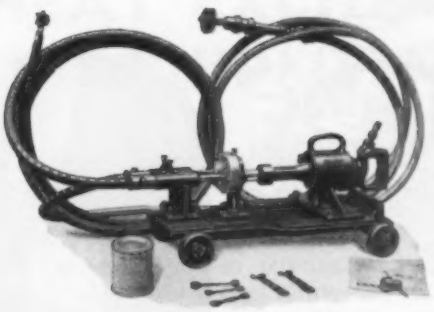
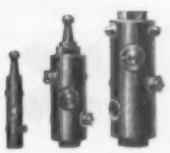
The Air Motor Driven Set incorporates all the advantages of a Rotary Air Tool without sacrificing the advantages of the electrically-driven Flexible Drive type.

"Skatoskalo" equipment can be used with complete safety and is recommended for the efficient maintenance of cracking plant, boilers, evaporators, condensers, heat exchangers, etc.

Tubes of 5/8" internal dia. upwards can be thoroughly cleaned by "Skatoskalo" Air Tools.





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P. B. Caldwell

PAUL B. CALDWELL has been appointed assistant to the marketing vice president, Shell Oil Co. His specific duties will be to aid in further development of the company's long established program in the jobber and distributor fields. Mr. Caldwell was formerly manager of Shell's Duluth, Minn., marketing district and has had close association with jobbers throughout his career. In addition to coordinating jobber-distributor activities for marketing executives in the head office of Shell, Mr. Caldwell will cooperate with division managers throughout the country. The new position supplements present marketing activities and does not affect established working responsibilities between the Shell organization and individual jobbers and distributors.

FRANK A. KLOF has been appointed advertising manager of the Standard Oil Co. (Ohio). He has been the assistant general sales manager of the Cleveland Electric Illuminating Co.

R. T. WATSON has been appointed manager of the Edmonton refinery of British American Oil Co., Ltd. He has been manager of the company's Calgary plant recently. In his 32 years with British American, he has served in many posts in the manufacturing department.

C. W. Coote succeeds Mr. Watson as manager of the Calgary plant. For the past four years he has been assistant manager of the plant. His former job is being taken by R. M. McDonald who has been transferred from Turner Valley where he was manager of the absorption plant. He previously has served at the Moose Jaw and Clarkson refineries.

A third change in the refinery management group of British American was the appointment of M. T. Stevens as manager of the Clarkson, Ont., plant. He has been with the company since 1935 and has managed plants at Moose Jaw, Calgary, and Edmonton.

J. B. GODWIN, process superintendent in the Beaumont refinery of Magnolia Petroleum Co., will be transferred temporarily to Coryton, England, as superintendent of the new 20,000-bbl. refinery being built by Vacuum Oil Co., Ltd., and Powell Duffryn. Others to be transferred temporarily from Beaumont to Coryton are: H. T. Fuller, Jr., who will be assistant refinery superintendent; Harold Ezell, assistant foreman of the Beaumont lube plant, who will be operating foreman for lubricating oils; and J. E. Perkins, who will be operating foreman for petroleum light ends.

F. L. MARTIN has resigned as vice president of Sunray Oil Corp. in charge of refining and pipe line operations to become president of Suntide Refining Co., Corpus Christi, Texas. Suntide is a new company which is being organized by Sunray and outside banking interests to build a new 25,000-barrel refinery on the Gulf Coast. The new plant will be equipped with catalytic cracking facilities.

P. C. Shea

PAUL C. SHEA, manager of the tankage and tonnage division in the supply department of Esso Standard Oil Co., has accepted his appointment as assistant director of supply and transportation for the Petroleum Administration for Defense. The appointment is effective July 1. Mr. Shea joined Esso in 1926 and has been engaged in manufacturing, supply and transportation activities throughout his career.

MELVIN S. HATTWICK has been appointed to the newly created position of director of advertising for Continental Oil Co., Houston. He will devote himself to research, creative phases, and measurement of effectiveness of Conoco's advertising. W. A. Morgan will continue to serve as advertising manager, with headquarters in the company's general offices at Ponca City.

Mr. Hattwick is the author of two advertising and sales textbooks, "How to Use Psychology for Better Advertising," and "Tested Ideas for Better Advertising."

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Oxo Alcohol Plant for Indiana Standard

Standard Oil Co. (Ind.), has named the M. W. Kellogg Co. to construct a large iso-octyl alcohol plant at its Wood River (Ill.) refinery.

The plant is divided into three basic parts: a fractionation system for obtaining heptene as a "heart cut" from an olefin feed stock; a refinery gas reformer for preparation of hydrogen and carbon monoxide; and finally, the actual iso-octyl alcohol section where the heptene, hydrogen and carbon monoxide are synthesized into the end product. Process design for the last-named unit will be Standard's. The other two sections will be Kellogg designs.

LEIGH S. McCASLIN, JR. has been named advertising and sales promotion manager of Deep Rock Oil Corp. The new department manager joined Deep Rock in July of 1951 as advertising assistant. During World War II he served 44 months with the U. S. Corps of Engineers, including two years in the Pacific theater, and was a major upon discharge in 1946.

PAUL G. BLAZER, chairman of Ashland Oil & Refining Co., was the recipient of an honorary Doctor of Laws degree at the University of Kentucky's 85th annual commencement in Lexington. This is the second honor conferred on Mr. Blazer by the university. He received the Sullivan Medallion as outstanding Kentucky citizen in 1948.

J. B. GWALTNEY, formerly sales manager for The California Oil Co., Chicago division, has just opened an office in New York City and will operate as Gwaltney Petroleum, Inc., at 30 Rockefeller Plaza. Mr. Gwaltney spent 11 years with The California Oil Co., a wholly owned subsidiary of Standard Oil Co. of California.

C. B. Marshall *H. J. Schlereth*

C. B. MARSHALL, a director for the past three years, has been elected a vice president of Standard-Vacuum Oil Co., and H. J. Schlereth, formerly an assistant treasurer, has been elected secretary.

Mr. Marshall, the new vice-president, started his petroleum career as a marketer in India 32 years ago. Following a series of sales assignments in Madras, Calcutta and Bombay, he was named general manager of the company's marketing organization for pre-war India.

During the war Mr. Marshall was directly concerned with Stanvac's part in supplying high-octane gasoline and other petroleum products to military forces in India, Burma, Ceylon and parts of China. He was chief negotiator last October and November in an agreement with the Government of India under which Standard Vacuum will build a $35 million refinery at Bombay.

Mr. Schlereth, the new secretary, succeeds H. H. Pethick who has resumed his status as a Stanvac annuitant after a year's temporary service in the position. Also a former marketer in the Far East, Mr. Schlereth's first assignment was in North China beginning in 1930. He filled similar positions in the Philippines before he was interned with his family at Santo Tomas prison during the war period. He served as district manager at Manila for two years prior to his selection as an assistant treasurer at Stanvac's New York office in 1947.

Heads du Pont Export Sales

Walter Mees has been appointed head of du Pont's newly established Petroleum Chemicals export sales section. Du Pont's export organization is being expanded to handle such petroleum chemicals as antiknock compounds, gasoline dyes and antioxidants, metal deactivator, grease stabilizers, lube oil additives and cetane.

Mr. Mees was born in Hengelo, Holland, and in 1929 joined the Royal Dutch Shell group, and served in South America and a number of European countries. He was management assistant of the Shell Caribbean Petroleum Co. in Venezuela before joining du Pont in 1950.

C. J. FRANCISCO has been appointed manager in charge of technical activities for Sinclair Research Laboratories, Inc., Harvey, Ill.

Mr. Francisco joined the Sinclair organization in 1941 in the pilot plant division. During the war he was loaned for several important defense committee activities. At the conclusion of hostilities, he directed the activities of Sinclair's process design group and later was appointed research director of the cracking division.

E. KEITH LEWIS, formerly superintendent at Winnipeg, Manitoba, has been named superintendent of Imperial Oil Company's refinery on Burrard Inlet. Charles M. Scryngemour, former Ioco superintendent, goes to Montreal as general superintendent while W. A. Murray, formerly assistant superintendent at Ioco, has also moved to Montreal as superintendent. G. G. Paterson, formerly of Sarnia, Ontario, succeeds Mr. Murray at Ioco.

GEORGE NOLLEY of Midland, Texas, formerly field representative there for Cities Service Oil Co.'s crude oil purchases and sales department, has been transferred to Bartlesville, Okla., in charge of field operations for the department. He is succeeded by Alan C. Roberts.

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CATHCART : GLASGOW

Chemical Plant Contract Let

Lion Oil Co. has let contracts covering the design and construction of its new Barton Chemical plant to be constructed at Luling, La. Chemical Construction Corp. is to be architect-designer and The Lummus Co. will be the prime contractor for construction. Estimated completion date is early in 1954. Products to be manufactured include anhydrous ammonia and prilled ammonium nitrate. Natural gas for processed material and fuel will be supplied by The Texas Co. from nearby fields in Louisiana.

Sinclair Bulk Terminal

Sinclair Refining Co. has purchased a 25-acre site just south of Spartansburg, S. C., and adjoining both the Plantation Pipe Line Company's system and the Southern Railway. In making this announcement, P. C. Spencer, president of Sinclair, stated that the company plans to erect a modern bulk terminal for the distribution of its products in an area of approximately 100-mile radius, which will include parts of North Carolina and Georgia as well as South Carolina.

To Install Five Platforming Units

Anglo-Iranian Oil Co., Ltd., has announced plans to install five UOP Platforming units. Two will be built in the United Kingdom, one will be built in France, one in the Aden area and the fifth in Australia. Four will have a design capacity of 6,000 bpsd, and the fifth 12,000 barrels. Universal Oil Products Co. has started engineering and design work on the five units.

Circuit Breaker Booklet

A complete study of Type AB circuit breakers is given in a new 35-page booklet available from the Westinghouse Electric Corp., Pittsburgh, Pa. Construction details, ratings and dimensions, and typical application information is given for each of eight types of AB breakers.

Governor Johnston Murray of Oklahoma recently announced plans to tour 13 Latin American countries, and personally present invitations to government and oil industry leaders to attend the May 14-23, 1953 International Petroleum Exposition. Here, left to right, Jay P. Walker, an exposition director, Lieut. Gov. James Berry of Oklahoma, Gov. Murray, and W. G. Skelly, exposition president, examine one of the specially prepared engraved invitations which Murray will present to officials. Delegates from 43 nations were present at the last exposition, held in 1948, and Skelly predicts an even greater representation for the forthcoming oil show. Gov. Murray will leave on his tour about August first.

Names Rubber Technologist

The Rubber Chemicals Division of E. I. du Pont de Nemours & Co. has named R. W. Malcolmson technical representative for the Southwest. His headquarters are in Houston. Mr. Malcolmson's appointment will provide the petroleum industry with a new source of technical assistance in the development of rubber products for service in the oil fields and refineries of the region.

Appoints Industrial Sales Manager

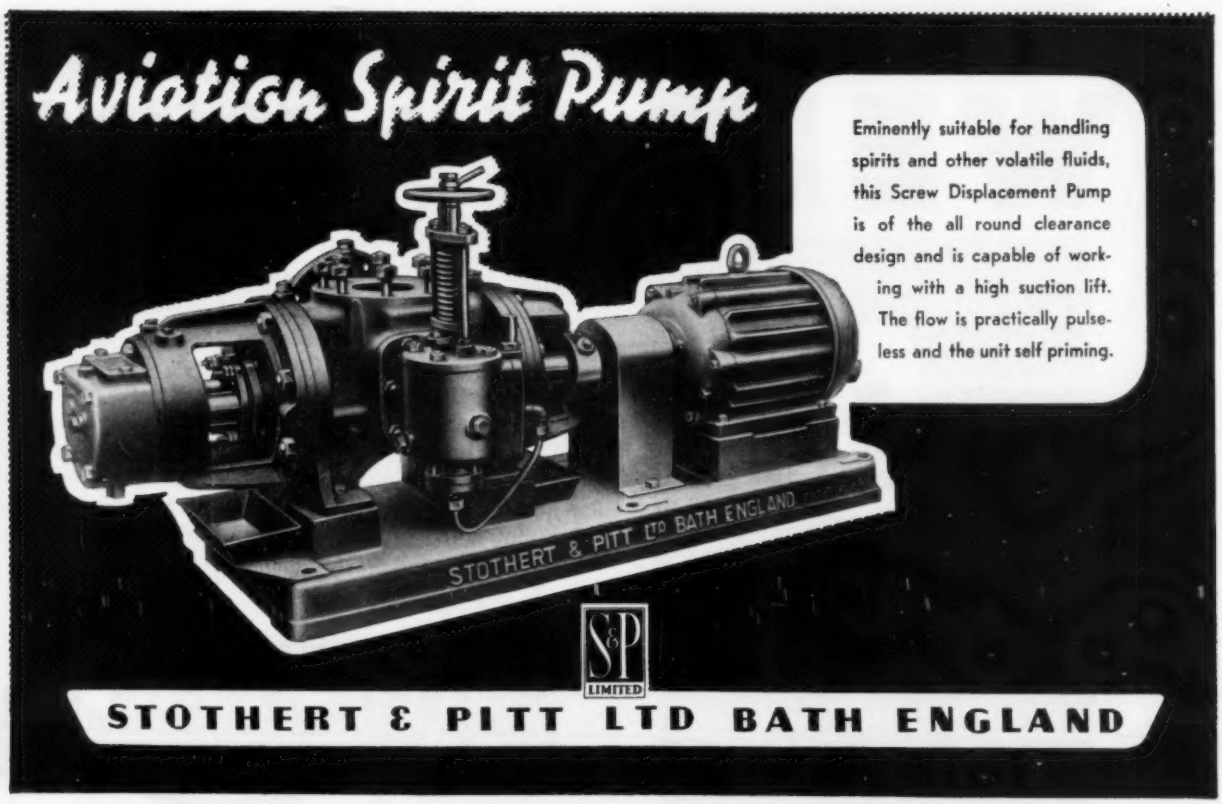
Westinghouse Electric Corp., Pittsburgh, Pa., has appointed F. D. Weatherholt as sales manager of industrial products. He formerly was manager of the apparatus division's industrial department at East Pittsburgh.

First Quarter Earnings Rise

Earnings of 43 oil companies in the first quarter of the current year were 5.8 percent higher than in the same period a year ago. Aggregate earnings of the group was $455,671,000 as compared with $430,837,000 in 1951.

In the group listed below, it will be noted that 19 companies reported increases in earnings and 24 companies showed reductions. Largest increase was shown by Standard Oil Co. (N. J.) totaling $14 million. Socony-Vacuum increased its net by $4 million, Gulf by $3.4 million, Sinclair by $2.6 million and Shell by $2 million. Among the smaller companies, Ashland Refining Co. increased its earnings nearly a million dollars in the quarter.

	1st Quarter Net Income (Thousands of Dollars)		Per Share Of Common	
	1952	1951	1952	1951
Amerada	$ 4,261	$ 4,171	$1.35	$1.32
American Maracaibo	836	910	.44	.47
Anderson Pritchard	1,533	1,798	1.88	2.21
Ashland Oil	4,072	3,125	.72	.66
Chicago Corp.	1,454	1,409	.41	.40
Colon Development Corp.	2,413	1,845	..	..
Continental	9,386	11,071	.96	1.14
Deep Rock	304	631	.68	1.40
Derby Oil	90	286	.20	.65
Gulf Oil	35,320	31,972	1.56	1.41
Honolulu Oil	2,079	1,889	1.11	1.00
Houston Oil	1,913	1,916	1.74	1.74
Imperial Oil Ltd.	9,193	8,049	.31	.30
International Pet. Co., Ltd.	7,200	7,000	.50	.48
Lion Oil	3,330	3,083	1.24	..
Louisiana Land & Exploration Co.	1,941	2,257	.65	.76


Aviation Spirit Pump
Eminently suitable for handling spirits and other volatile fluids, this Screw Displacement Pump is of the all round clearance design and is capable of working with a high suction lift. The flow is practically pulseless and the unit self priming.
STOTHERT & PITT LTD BATH ENGLAND
S&P LIMITED
STOTHERT & PITT LTD BATH ENGLAND

	1st Quarter Net Income (Thousands of Dollars)		Per Share Of Common	
	1952	1951	1952	1951
Maracaibo Oil Exploration Co.	77	73	.15	.16
Mid-Continent	4,053	4,398	2.18	2.37
Middle States	841	974	.39	.45
Pacific Western	4,110	4,465	.98	.95
Panhandle	294	374	.18	.23
Phillips Pet.	19,772	15,882	1.37	1.10
Pure Oil	7,173	7,213	1.66	1.67
Quaker State	388	572	.42	.62
Richfield	5,689	6,939	1.42	1.73
Shell Oil	24,284	22,394	1.80	1.65
Seaboard Oil Co. of Delaware	1,151	1,827	.94	1.49
Sinclair Oil	20,970	18,397	1.71	1.52
Skelly Oil	7,360	7,261	2.56	2.52
Socony Vacuum	41,000	37,000	1.29	1.16
Standard Oil Co. of Calif.	41,791	38,402	1.46	1.34
Standard Oil Co. of Ind.	31,285	33,749	2.04	2.21
Standard Oil Co. of Kentucky	2,423	2,425	.93	.93
Standard Oil Co. of N. J.	132,000	118,000	2.18	1.95
Standard Oil Co. of Ohio	4,430	4,702	1.05	1.23
Sunray Oil	5,625	6,057	.52	.57
Swan Finch Producing Co.	833	822	.75	.74
Tide Water Assoc. Oil Co.	6,750	8,910	1.06	1.39
Union Oil Co. of Calif.	6,700	6,645	1.23	1.22
Universal Consolidated Oil Co.	393	686	1.35	2.46
Venezuela Pet.	734	991	.18	.25
Wilcox Oil Co.	213	232	.76	.83
TOTAL	$455,671	$430,837		
Increase, %—5.8%				

J. R. Hutchison

Worthington Names Mid-East Manager

J. R. Hutchison has been appointed regional manager of the Middle East division by Worthington Corp., according to an announcement by S. R. Williams, vice president in charge of foreign business. He will direct Worthington's activities in Cyprus, Egypt, Greece, Iran, Iraq, Israel, Lebanon, Syria, Trans-Jordan, and Turkey. He will he headquartered in Istanbul, Turkey.

American Meter Promotes Beck

Appointment of H. V. Beck as application engineer has been announced by William G. Hamilton, Jr., president of the American Meter Co. Mr. Beck has been with American Meter for the past 16 years and was assistant manager of the company's metric works in Erie, Pa., prior to his present appointment.

S. O. Indiana Promotes Butterworth

L. H. Butterworth has been promoted to a new position as manager of operations, cost control, and personnel division of the manufacturing department of Standard Oil Co. (Ind.) in the general office at Chicago. C. A. Cogan will succeed him as assistant general superintendent of the company's Casper, Wyo., refinery. Mr. Cogan has been superintendent of the projects, capital expenditures, and miscellaneous contracts sections in the manufacturing department of the general office.

Mr. Butterworth joined Standard in 1937 as a chemical engineer in the research department at Whiting, Ind. In 1942 he was transferred to the manufacturing department as an assistant general foreman in the light oils division at the Whiting refinery. He was promoted to assistant general superintendent of the Casper refinery in 1947.

Tide Water Publication Wins Award

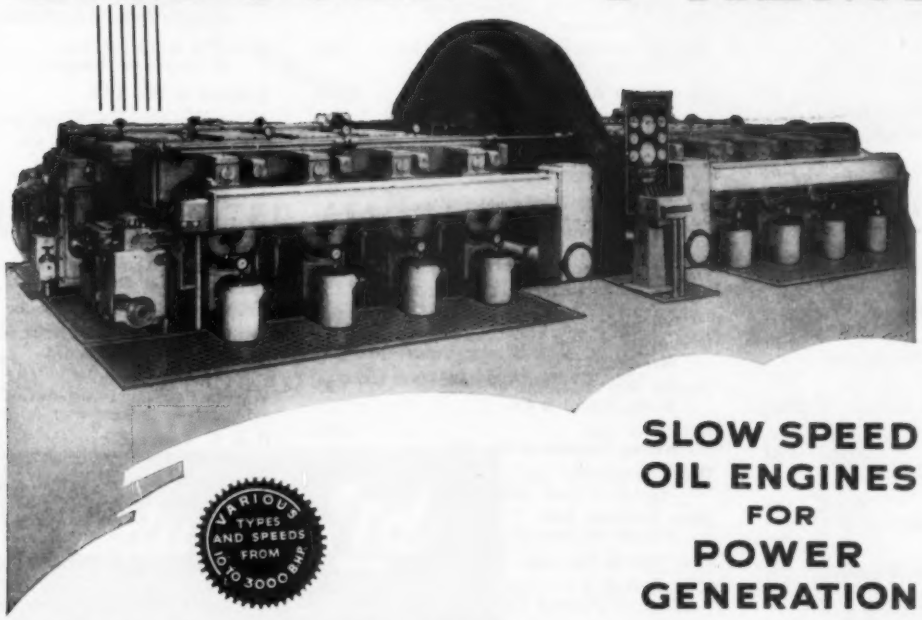
For making outstanding contributions to freedom during 1951, the Refinery News, employee publication of the Tide Water Associated Oil Co. and Jack F. Gow, of Paterson, N. J., supervisor of company publications in the Eastern Division, have received honor medal awards from the Freedoms Foundation.

The honor medals were presented to Mr. Gow, who is also Bayonne public relations representative for the Tide Water Associated Oil Co., at regional ceremonies held at the Federal Hall Memorial, Sub-Treasury Building, New York.

Burns Joins Catalytic Construction

Weldon Riley Burns has joined Catalytic Construction Co. in its oil refinery division as a senior project engineer. He formerly was with the Badger process division of Stone and Webster Engineering Corp. as a project engineer. Previously he had been plant superintendent for the Frontier Refining Co. in Cheyenne, Wyo. and for Northwestern Refining Co., St. Paul, Minn.

CROSSLEY-PREMIER



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ADVERTISER'S INDEX

(Advertising Agencies in Italics)

American Cyanamid Co. 70
Hazard Advertising Co.

Anglo-Iranian Oil Co., Ltd. 141
S. H. Benson Ltd.

Arabian American Oil Co. 34

Babcock & Wilcox Ltd. 54
S. H. Wright & Co. Ltd.

Badger Process Division, Stone & Webster, Inc. 48
Thames Advertising Service Ltd.
Harold Cabot & Co., Inc.

Bethlehem Steel Co. 66
Gotham Advertising Co., Inc.

C. F. Braun & Co. 36-37
John C. Fellows Co.

British Ropes Ltd. 145
D. J. Keymer & Co. Ltd.

Peter Brotherhood Ltd. 122
Rooster Publicity Ltd.

Brown Fintube Co. 46
Henry T. Bourne Advertising Agency

The Butterley Co. Ltd. 13
Rowlinson-Broughton

California Texas Oil Co., Inc. 42
Cunningham & Walsh, Inc.

The Cape Asbestos Co. Ltd. 56
Industrial Publicity Service Ltd.

Carbometals Ltd. 50, 135
Rooster Publicity Ltd.

Caswell Crane & Erection Ltd. 53
Rooster Publicity

Chemical & Insulating Co. Ltd. 12
Stowe & Bowden Ltd.

Chicago Bridge & Iron Co. 1
Russell T. Gray, Inc.

Cities Service Companies 131
Albert Frank-Guenther Law, Inc.

Consolidated Engineering Corp. 33
Hixson & Jorgensen, Inc.

Consolidated Pneumatic Tool Co. 67
Crane Publicity

The Cooper-Bessemer Corp. 38
The Griswold-Eshleman Co.

Costain-John Brown Ltd. 153

Crane Co. 55
The Buchen Co.

Crane Packing Ltd. 166

Crossley Premier Engines 163
Osborne-Peacock Co. Ltd.

Davison Chemical Corporation 6-7
St. Georges & Keyes, Inc.

Dikkers & Co. 21
Nederlands Reclame-Adviesbureau Ir J. Bauduin

E. I. du Pont de Nemours & Co. 17-18
Charles L. Rumrill & Co.

Dunlop Rubber Co. 64
Charles F. Higham Ltd.

English Electric Co. 41
Service Advertising Ltd.

Ethyl Corporation 3
Batten, Barton, Durstine & Osborn

Evershed & Vignoles Ltd. 65
E. Walter George Ltd.

William E. Farrer, Ltd. 147

Flexible Drives (Gilman's) Ltd. 159
Boswell & Barratt Ltd.

The Fluor Corporation Ltd. 28-29
Dozier, Eastman & Co.

The General Electric Co. Ltd. 8
Greenly's Ltd.

Gilbert & Barker Manufacturing Co. 151
McCann-Erickson Corporation

Gourock Ropework Co. Ltd. 147
Sommerville & Milne Ltd.

Graver Tank & Mfg. Co., Inc. 2
Simmonds & Simmonds, Inc.

Gulf Oil Corporation 9
Young & Rubicam, Inc.

Matthew Hall & Co. Ltd. 30

Halliburton Oil Well Cementing Co. 72
Hill & Christopher, Inc.

Harland & Wolff Ltd. 132

G. A. Harvey & Co. (London) Ltd. 119

Holman Brothers Ltd. 59
W. E. Barney Ltd.

Houdry Process Corporation 61-63
John Falkner Arndt & Co.

Hudson Engineering Corp. Cover III
Brennan Advertising Agency

Hurst-Nelson & Co. Ltd. 135
Osborne-Peacock Co. Ltd.

International General Electric Co. 60
Grant Advertising, Inc.

International Paints Ltd. 160
Mayfair Advertising Ltd.

The M. W. Kellogg Co. 19
Gordon Baird Associates, Inc.

Wm. Kenyon & Sons 39
Rowlinson-Broughton

Richard Klinger Ltd. 139
S. H. Wright & Co. Ltd.

Koch Engineering Co., Inc. 155
The Lago & Whitehead Co.

N. V. Koninklijke, Ketjen 14
Raedt en Baet Adviesbureau voor Reclame

Lafarge Aluminous Cement Co. Ltd. 129
Allardyce Palmer Ltd.

John Laing & Son Ltd. 121

Lake & Elliot Ltd. 165
Ripley, Preston & Co. Ltd.

Lincoln Electric Co. Ltd. 126

Lionweld Ltd. 15
Kidds Advertising Ltd.

London & Midland Steel Scaffolding Co 123
S. H. Wright & Co. Ltd.

The Lummus Co. 57
Harris D. McKinney Organization

Sir Robert McAlpine & Sons Ltd. 137

Arthur G. McKee & Co. 25
Meerman's, Inc.

Charles Martin & Co. 27
Rives, Dykes & Co.

Metaducts Ltd. 165
Ripley, Preston & Co. Ltd.

Metal Containers Ltd. 35
Murray-Watson Advertising Service

Moon Brothers Ltd. 58
Donald MacDonald Advertising Ltd.

Wm. Neill & Son Ltd. 52

A. P. Newall & Co. Ltd. 20
Osborne-Peacock Co. Ltd.

Newalls Insulation Co. Ltd. 23
Thomas Reed & Co. Ltd.

Nicerol Ltd. 31
Townsend-Smith Ltd.

Nordstrom Valve Division 40
Marsteller, Gebhardt & Reed, Inc.

Samuel Osborn & Co. Ltd. 159

Pacific Pumps, Inc. 45
The McCarty Company

Pacific Valves, Inc. 32
Harold H. Larsen Advertising

Petroleum Rectifying Co. 47
John C. Fellows Co.

Port of Bristol Authority 122

D. & C. & Wm. Press Ltd. 127
Rooster Publicity Ltd.

J. F. Pritchard & Co. 10
Carter Advertising Agency, Inc.

Procon, Inc. 68-69
Simmonds & Simmonds, Inc.

Pulsometer Engineering Co. Ltd. 158

Pure Oil Co. 4
Leo Burnett Co., Inc.

Pyrene & Co. Ltd. 44
Nelson Advertising Service Ltd.

The Quaker Oats Co. 43
Rogers & Smith, Advertising

Refinery Engineering Co. 117
Watts, Payne Advertising, Inc.

Schlumberger Well Surveying Co. 113
Rives, Dykes & Co.

Sigmund Pump Ltd. 143
Redheads Advertising Ltd.

Socony-Vacuum Oil Co. 26
Compton Advertising, Inc.

South Durham Steel & Iron Co. Ltd. 150
Tully-Crabbe Ltd.

Spirax Manufacturing Co. 145

Standard Oil Co. (N.J.) 16
McCann-Erickson Corporation

Standard Vacuum Oil Co. 51
Sam J. Gallay Advertising

Stewarts & Lloyds Ltd. 114
H. Raymond Morgan

Stothert & Pitt Ltd. 162

Sun Shipbuilding & Drydock Co. 22
Benjamin Eshleman Co.

Telegraph Construction & Maintenance Co. Ltd. 145
G. Street & Co. Ltd.

John I. Thornycroft & Co. Ltd. 143

Tide Water Associated Oil Co. 49
Lennen & Mitchell, Inc.

Universal Oil Products Co. 124-125
Simmonds & Simmonds, Inc.

Henry Vogt Machine Co. 24
Farson, Huff & Northlich Advertising

Warren Petroleum Corporation Cover II
Gibbons Advertising Agency

G. & J. Weir Ltd. 161
Scottish Industrial Advertising

Westinghouse Electric International Industries 149
National Export Advertising Service, Inc.

George Wimpey & Co., Ltd. 134

Worthington Corporation 11
James Thomas Chirurg Co.

Wyatt Metal & Boiler Works Cover IV
Wallace Davis & Co.

Youngstown Sheet & Tube Co. 5
The Griswold-Eshleman Co.

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PETROLEUM FITTINGS

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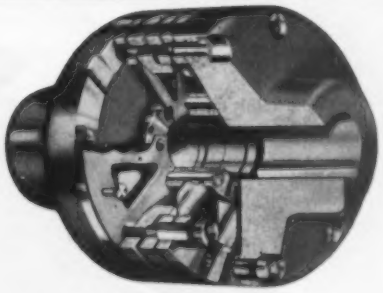
Cast Steel Fittings for oil refinery and chemical plants are manufactured throughout at Braintree by Lake & Elliot Ltd. Close metallurgical control is maintained by competent chemists working with modern apparatus. The independent inspection department can carry out inspection, or work in conjunction with customers own inspectors.

Lake & Elliot Ltd.
BRAINTREE ENGLAND

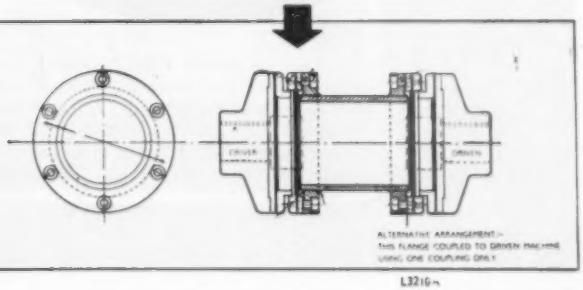
A UNIQUE COUPLING WHICH IS TRULY *flexible*



METASTREAM PATENTED ALL METAL COUPLINGS

An all metal coupling which permits angular misalignment and adequate axial movement between driving and driven units. There are no sliding or rolling members, no springs, gears, chains or rubber mountings. The extreme measure of flexibility provided is achieved **without the need of any form of lubrication whatsoever.**

The Metastream Spacer Coupling, shown below comprises two Metastream couplings and a central spacer, built into one unit. The design permits a measure of angular and lateral misalignment, and provides maximum accessibility of the driven machine by removal of the spacer.



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IN relation to the vast array of plant and equipment which makes up the modern oil refinery, an assembly of gland packings is a small, almost insignificant component. But for all that, packings perform an important function, and we devote a very substantial proportion of our resources to the manufacture of those high-performance packings which are used at critical stages in refining processes.

Such packings, as every refinery engineer knows, are used in conditions of exceptional severity when they may simultaneously be subjected to high temperatures and pressures, severe chemical action, and to mechanical stresses and wear arising from contact with a rapidly rotating shaft. The performance of packings in these particularly arduous service conditions is governed by the degree of skill with which materials are selected and their physical properties brought into balanced combination within the basic form of a packing.

Foremost among the considerations which press upon a manufacturer of this particular class of packings, is the need to keep in step with continuing developments in the scale and techniques of refinery operations and to this end we have recently reinforced our facilities for research and development. Since 1949, we have equipped new laboratories, new test rooms and a new machine shop, and we have also established a much more effective system of control to ensure that uniform standards are maintained throughout the entire output of each style of packing. This, in our view, is a timely addition to our strength, which cannot fail to influence beneficially our ability to co-operate with refinery engineers on matters of mutual concern.

This is a spiral of CRANPAC Style 100 AL, a packing extensively used to seal the glands of pumps handling oils and petroleum distillates at high temperatures and pressures. The basic material used in the construction of this packing is a selected grade of aluminium foil which is tension-wrapped around an unlubricated core.

Crane Packing Ltd OF SLOUGH ENGLAND

After two years of development and test work confirmed in the operation of the large West Texas installation pictured below,

HUDSON presents the

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A New Type Cooling System Integrated for All Process Plant Cooling Services, Combining the Economical Maximum Use of Air With Minimum Use of Water.

In the COMBIN-AIRE the use of air for cooling is extended to include low temperature cooling services previously necessitating water cooling because of high ambient air temperature. The COMBIN-AIRE allows the use of air-cooling for total heat dissipation in all services.

The COMBIN-AIRE is a combination of a HUDSON water cooling tower with HUDSON air-cooled exchangers housed in one integrated structure. During periods of high ambient temperature the inlet air is first drawn through water at the bottom of the cooling tower, reducing the air to near wet bulb temperature, at which temperature it contacts the air-cooled exchangers. During periods of low ambient temperature the inlet air is used directly in the air-cooled exchangers and no water is evaporated in the cooling tower.

When water in good quantity and quality is not available the COMBIN-AIRE has manifest advantages over any alternative combination of cooling equipment.

Even when ample water is available and water treatment costs are low, comprehensive comparisons will frequently indicate overall advantages of the COMBIN-AIRE system.

*** The COMBIN-AIRE unit is protected by United States patents**

COMBIN-AIRE ADVANTAGES

- **LOW WATER CONSUMPTION.** No water is used during cold weather.
- **NO TREATMENT NECESSARY** for cooling tower water.
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- **NO CONDENSATION** from effluent air.
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- **CLEAN AIR TO AIR-COOLED UNITS.** During hot season air is water-washed removing dust, sand and insects.

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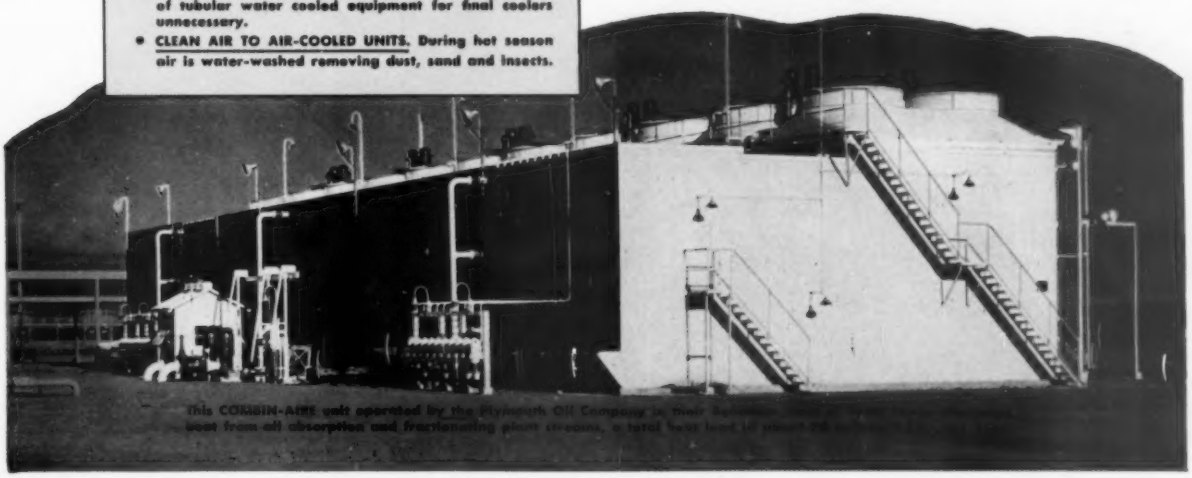
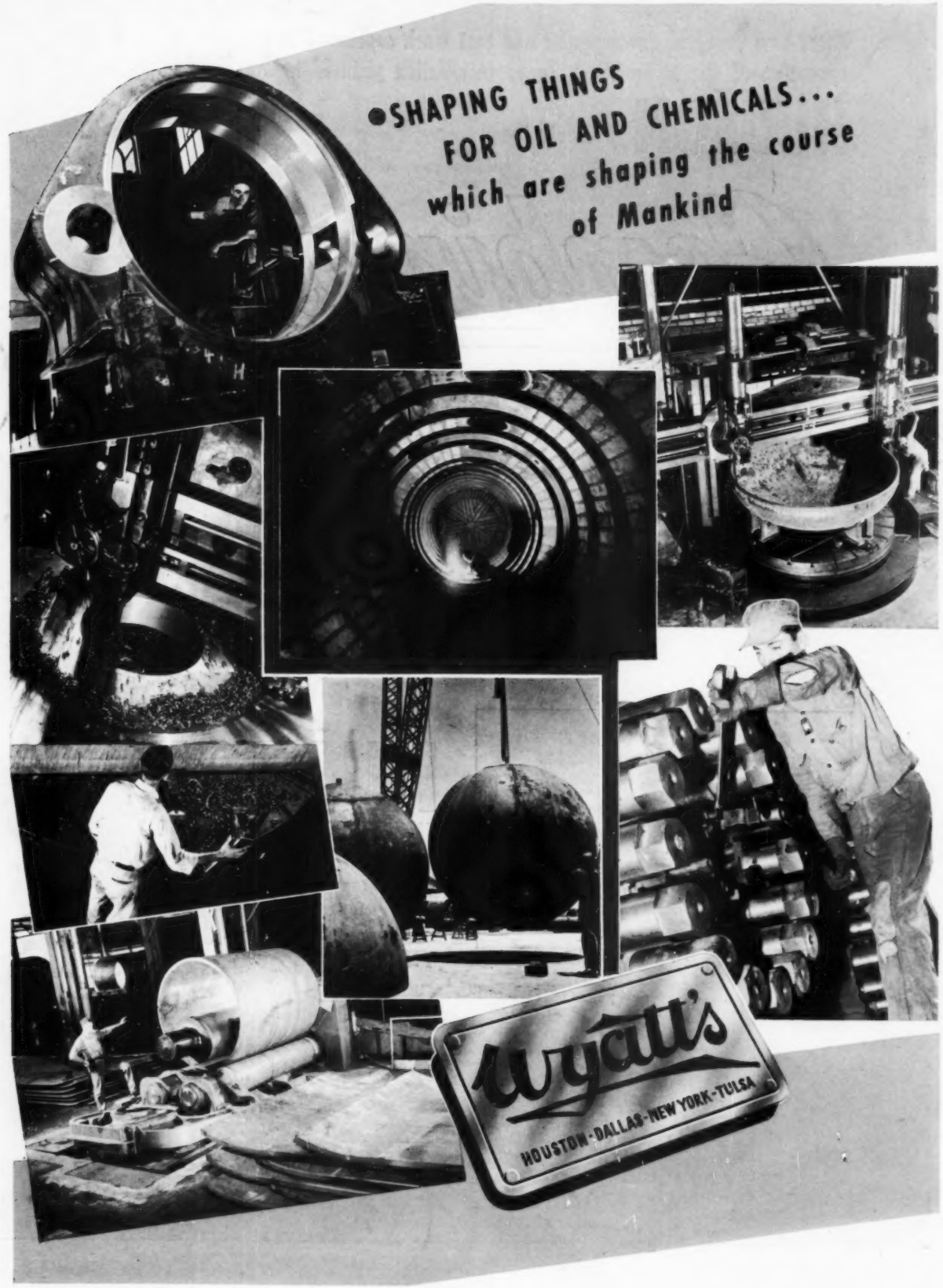


This COMBIN-AIRE unit operated by the Plymouth Oil Company in their Refinery at [illegible] boost from oil absorption and fractionating plant streams, a total heat load of [illegible]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